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Contemporary World Engineering Projects Series—15

Members are invited to contribute to this Series special articles featuring major engineering projects which they may have visited or with which they may have been associated in other manner. Articles should be preferably accompanied by photographs and illustrative sketches.

NAHORKATIYA GAS TURBINE POWER STATION*

In the Nahorkatiya and Moran areas in upper Assam, drilling of development and extension wells has proved very successful. As a result, the proven and indicated reserves of crude oil and natural gas are estimated at 291.4 million barrels and 719 billion c.ft., respectively. The capital outlay required for developing these new fields is computed at about Rs. 30 crores.

A planned and spaciously laid out township at Nahorkatiya, with its industrial and residential sectors, is rapidly taking shape. Arrangements for delivering the Nahorkatiya-Moran crude oil through a 16 in. diameter pipeline to the Nunmati refinery by the end of 1961 are making satisfactory progress. To meet the mounting requirement of electricity for the Nahorkatiya oil fields and the Zaloni township, the Nahorkatiya gas turbine power station was erected and was commissioned in April 1961. A general view of the power house showing the gas regulating and scrubbing equipment, exhaust chimneys and louvered air filter intake is given in Fig.1.

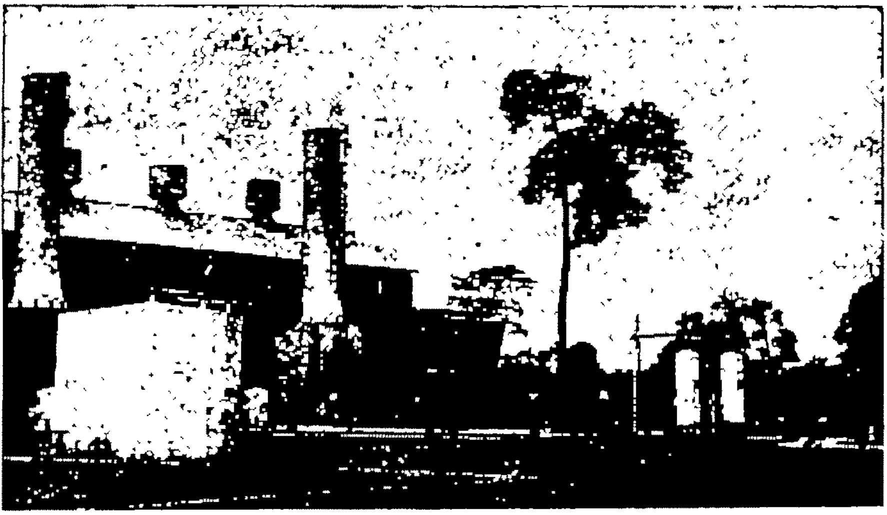

Fig. 1

Rear view of the Nahorkatiya gas turbine power station

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* Contributed by the Assam Oil Co., Ltd., Digboi, Assam.

The advantages of gas turbine power plant over steam or Diesel power plant, which more than outweigh its higher initial cost, are (i) compactness, (ii) lighter foundations, (iii) quicker starting, (iv) readily available local fuel, and (v) smaller requirement for cooling water. Also, it can be more readily silenced than a Diesel plant.

Till the first gas turbo-alternator set of 1,790 kW was commissioned, a number of small Diesel generating sets were used, which were inadequate to meet the increasing power demand in the area, and all oil field and domestic consumers had to restrict their electricity consumption to the generating capacity of these sets.

When the first turbo-generator set started operating, the initial load on the system was only 310 kW. However, the commissioning of a large number of electrically driven pump houses and other industrial installations at present under erection in different parts of the Nahorkatiya oil field, resulted in a substantial increase in the load.

Work on the power station building was started in July 1959 and completed in time to receive the first gas turbine set. Erection of electrical equipment was started in July 1960 and of mechanical equipment about three months later. The first gas turbine set was erected in March 1961 and was commissioned in May 1961. The second set was erected in May 1961, and the third set is expected on site in September 1961.

The gas turbine used for the power plant is English Electric type EM 27P, which is a long life, fully cooled, compact prime mover. It works on open cycle, and is equally suitable for both base load and peak load operations. The starting and load changing operations can be carried out rapidly without thermal stresses of any magnitude being set up in the component parts. Ease of operation is ensured by a comprehensive protection equipment installed with the set. Twin combustion chambers are provided to enable the use of either liquid or gaseous fuels. However, the Nahorkatiya turbo-alternator sets are arranged for burning natural gas in view of its availability from the oil fields in the vicinity. A general view of the turbine and the control desk is given in Fig. 2.

The turbine is coupled by means of a flexible drive shaft to the alternator which is driven through an epicyclic reduction gear. The gearbox is mounted on an extension of the alternator bed plate, and reduces the turbine speed from 7,050 to 1,500 r.p.m.

The turbine is of the split shaft type and comprises six stages of axial flow, and a centrifugal compressor driven by a two stage power turbine. Air is drawn into the compressor through a spoked intake casing. It passes through the various stages of the compressor and enters the space between the inner and outer compressor casings through a diffuser. After leaving the compressor delivery chamber, the air divides into two equal parts, each of which is ducted to the inlet flange of one of the twin combustion chambers. Fuel is introduced by means of a single gas burner on the top cap of each combustion chamber.

The hot gases resulting from the combustion of the fuel enter the main turbine inlet casing through two inlet elbows. From the inlet casing the gases expand through the two turbines which are arranged in series but rotate in opposite directions. After leaving the last turbine stage, the gases pass through a spoked exhaust outlet casing to the atmosphere.

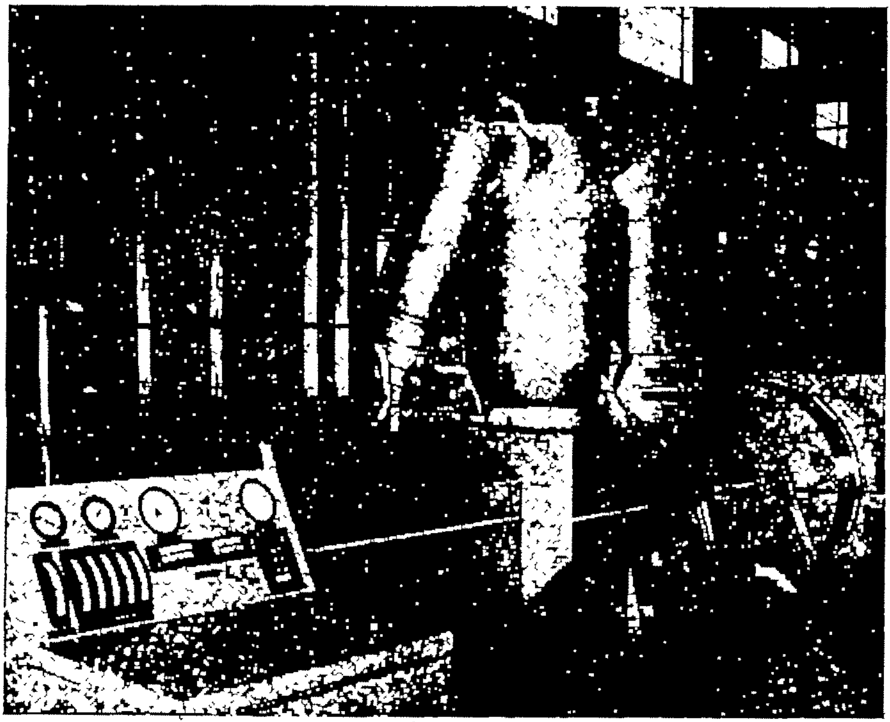

Fig. 2

General view of the gas turbine set and the control desk

For an intake temperature of 80°F., the turbo-alternator set has a continuous rating of 1,790 kW at the alternator terminals. The corresponding heat rate is 21,650 B.Th.U. per kWh, which is equivalent to a fuel consumption of approximately 22 c.ft. of natural gas per kWh.

The turbine is started with the help of a 7.5 h.p., 110 volts, D.C. motor which drives the charging rotor through an air operated disengaging clutch. The starting sequence is automatic, being initiated by depressing a push-button on the driving panel, after operating the master switch. This makes the panel live, and starts the auxiliary oil pump.

In addition to the starting and speed control equipment, the turbine control panel carries an audible visual alarm system, instrumentation indicating all major turbine operating conditions, and relays controlling the timing of the starting sequence.

The lubricating oil system caters for the turbine, the servo system, the gearbox and the alternator. Oil is stored in the turbine base plate and circulated by means of a gear pump driven through the reduction gearbox. During starting and after shutdown, or when the lubricating oil pressure falls due to any other reason, a standby 110 volts D.C. motor driven pump takes over oil circulation. Fig. 3 shows the starting motor with the associated control panel and standby lubricating oil pump.

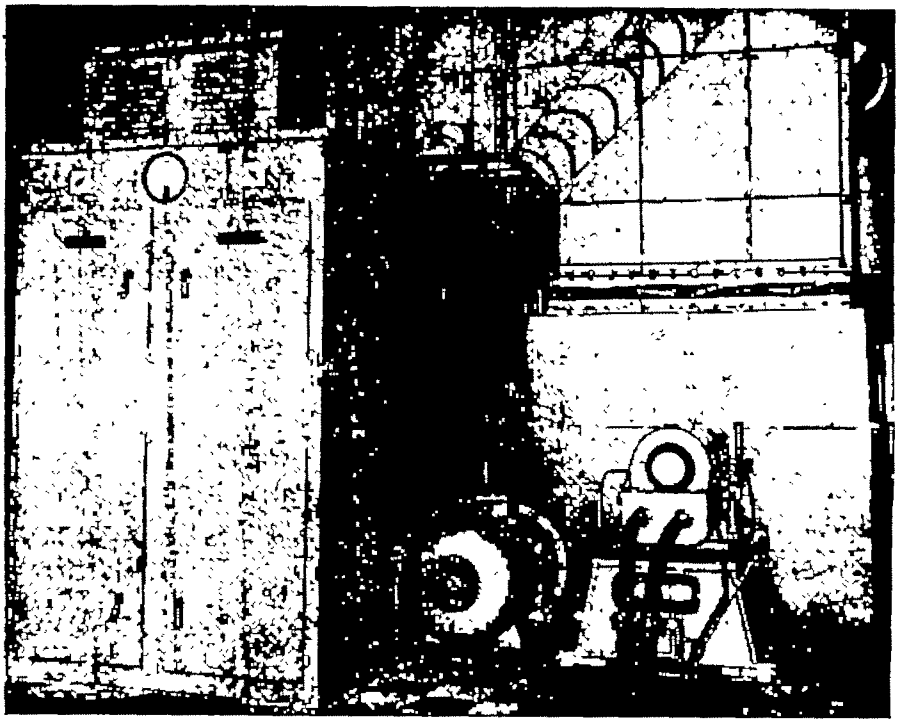

Fig. 3

Starting motor with the associated control panel

Air intake filters are provided to prevent dirt from depositing in the compressor and thereby causing a drop in the engine output. These filters are of the moving screen, oil wetted type. A silencer is fitted which consists of a series of acoustically lined slats placed just after the filters. These slats prevent transmission of high frequency noise from the intake.

Mild steel ducts carry air from the silencer and filter assembly to the compressor intake. Mild steel exhaust ducting, sprayed internally with aluminium because of the high temperatures encountered during operation, leads the gases to the base of a short self-supporting steel stack.

The alternators are rated at 2,500 kVA, 1,500 r.p.m., 11 kV, 50 cycles per sec., 3-phase, and are of salient pole construction with a single outboard bearing. The driving end of the rotor of the alternator is supported on the low speed gearbox bearing. The main and pilot exciters are driven in tandem from the free end of the rotor. Fig. 4 shows one of the alternators with main and pilot exciters. The alternator is provided with open circuit ventilation, cooling air being drawn in by fans mounted on the rotor, and passes through filters mounted at each side of the stator frame.

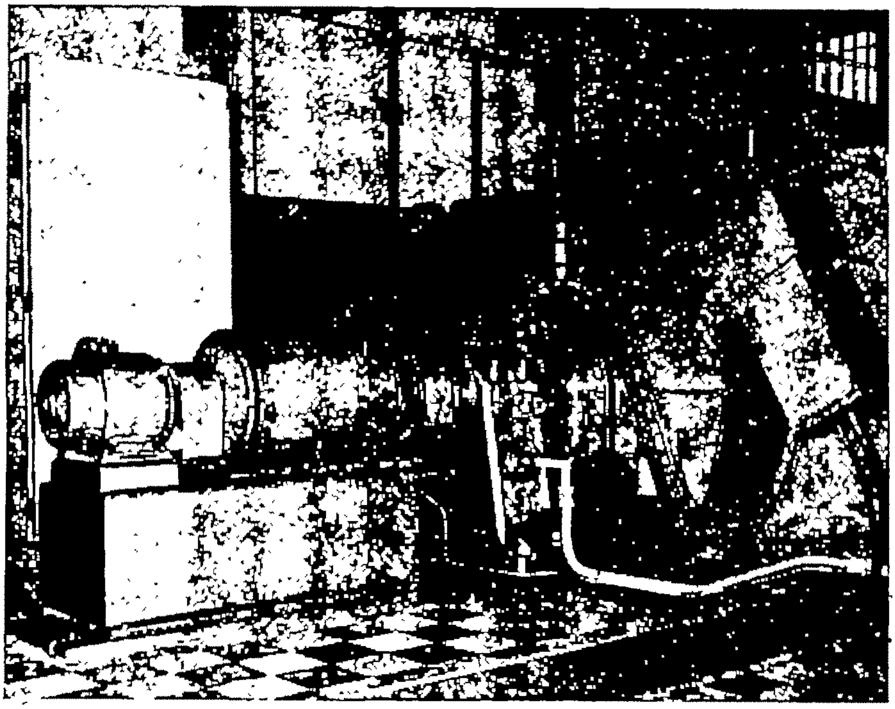

Fig. 4

The alternator with main and pilot exciters

The 11 kV switchgear is of the horizontal drawout, compound and oil filled, metal clad design, using a double busbar with on-load, oil immersed selector switches. It is fitted with de-ion grid arc control devices, and has a rupturing capacity of 250 MVA.

The 13-panel switchboard includes six oil circuit-breakers for outgoing feeders, three for the alternator, two for the transformer, one for the bus section, and a bus coupler. It is located in a fireproof room having internal fireproof dividing walls. The control room is located immediately above the main switchgear room, and houses the control board associated with the main switchboard and the alternator control desks. Each panel of the control board (Fig. 5) houses the protective relays and instrumentation concerning the oil circuit-breaker associated with it. The control board is fully mimicked to show the position of busbars and circuit-breakers, and is equipped with semaphore indicators and indicating lamps showing the state of the circuit-breakers, and in the case of the alternators, the position of field switches and neutral earthing circuit-breakers.

The alternator control desks house the instrumentation for each alternator, the field regulators, and the turbine speed control equipment. Each desk is equipped with an emergency 'stop' button, which will shut down the turbine by remote control in the event of an emergency. To protect the various relays, instruments and

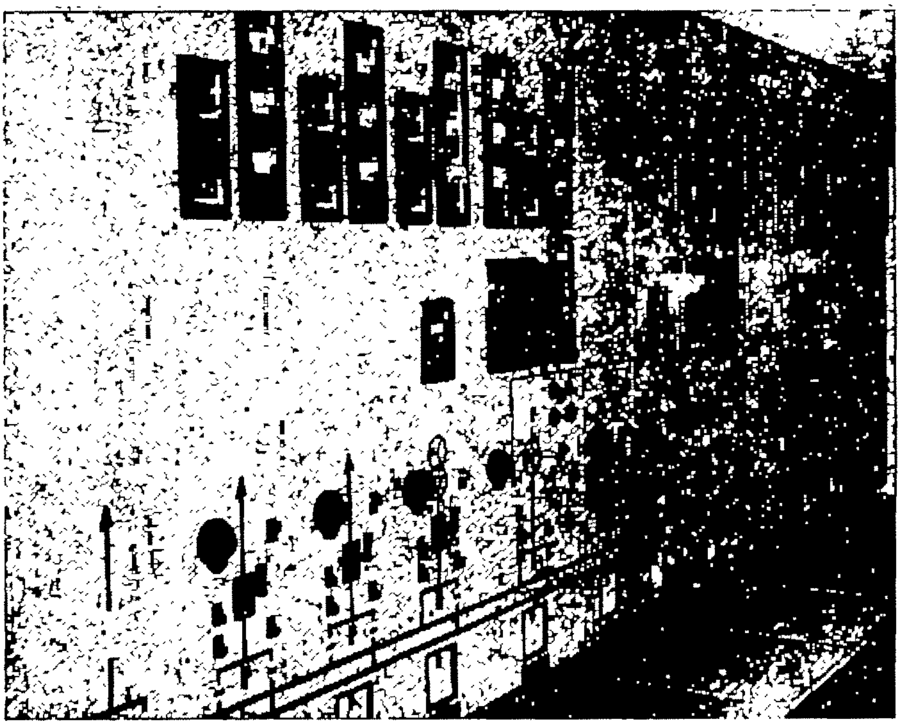

Fig. 5

A view of the remote control board

automatic voltage regulators from the humid climate in Assam, the control room is fully air-conditioned.

Next to the main switchgear room on the ground floor is the neutral earthing room which houses the neutral earthing resistances and the neutral earthing circuit-breakers. These are remotely operated from the control room.

The 400 volts station auxiliaries switchgear room is supplied by duplicate 250 kVA transformers. The transformer and bus section (400 volts) switches are of the solenoid operated air break type, whilst the station services are drawn through a combination fuse distribution switchboard duplicated about each transformer panel.

Compressed air for turbine instrumentation and servo pressure for the gas regulating valves is provided by two A.C. motor driven air compressors, with an automatic D.C. motor driven emergency standby compressor.

A battery installation has been provided to give 100 volts D.C. for starting the turbine, to supply power to the D.C. auxiliaries associated with the turbine for starting and stopping sequences, and circuit-breaker closing and emergency services. The installation includes two separate batteries and charging units, a 95-cell 270 amp.-hr. capacity nickel-iron battery for starting, and a 90-cell 450 amp.-hr. capacity nickel-iron battery for the auxiliary services.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Bihar Centre

Chairman's address by Shri P. R. Guha, B.C.E., M.I.E., at the 14th Annual General Meeting of the Centre on January 22, 1961

The Chairman welcomed the Chief Guest, Shri D. N. Sinha, Minister for Irrigation and Power, Bihar Government, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1960-61.

Delivering his address, Shri Guha briefly described the history of the Institution and the Bihar Centre, and explained its aims and objects. He then gave a brief review of the engineering activities in the State during the Second Plan, and the proposals for the Third Plan in the following words, 'The First Plan laid emphasis on irrigation, flood control, and power generation. The Second Plan laid emphasis on industries based on the power generated in the First and Second Plans. The Third Plan lays emphasis on both agriculture and industry. The Institution has on its Roll engineers of all branches, civil, mechanical, electrical, sanitary, communication, automobile, aeronautical, naval, etc. Therefore, it has a vital role to play in the development of the country

Irrigation and flood control

The total financial outlay for the Second Plan was Rs. 4,800 crores, out of which Rs. 898 crores was provided for irrigation, flood control and power projects. The provision for development of industries and minerals was Rs. 891 crores, and for transport and communication, Rs. 1,384 crores. Thus, the total provision for development through engineering works was Rs. 3,173 crores, *i.e.*, 69% of the total Plan expenditure. For Bihar State, the total provision was Rs. 193 crores, of which the provision for irrigation and power was Rs. 63 crores.

The total investment during the Third Plan is likely to be Rs. 10,200 crores, of which the provision for irrigation, flood control and power projects will be about Rs. 1,495 crores. The Third Plan for the Bihar State is likely to allot Rs. 343 crores, of which the irrigation and power sector is likely to get Rs. 146 crores, consisting of Rs. 76 crores for power and Rs. 70 crores for irrigation.

In the beginning of the First Plan, about 1,037,000 acres were under irrigation in the State. This was increased by about 500,000 acres by the end of the Plan. The target at the end of the Second Plan was to increase this by about 750,000 acres. At the end of the Third Plan, it is expected to bring under irrigation an additional area of about 3,100,000 acres, thus bringing the total irrigated area to 5,400,000 acres. Bihar has a cultivated area of about 23,300,000 acres. A Master Plan for providing irrigation facilities to 10,400,000 acres at a cost of about Rs. 184 crores has already been prepared.

By the end of the Second Plan, about 2,100,000 acres will be protected from floods in the State at an expenditure of about Rs. 56 crores. The expenditure during the Third Plan is expected to be about Rs. 3 crores for protecting additional 100,000 acres.

Kosi project

The work on the Kosi project is in full swing, and the project is expected to be completed during 1962-63. The Planning Commission have agreed to sanction the Western Canal system, as well as the extension of irrigation facilities to certain areas on the eastern side. On completion, this project will ensure irrigation to an area of about 2,200,000 acres.

Gandak project

This project envisages construction of a barrage across the River Gandak for providing irrigation facilities to 3,162,000 acres in the districts of Saran, Champaran, Muzaffarpur and Darbhanga in Bihar, about 1,200,000 acres in the districts of Gorakhpur and Deoria in Uttar Pradesh, and about 150,000 acres in Nepal. The project also envisages generation of hydro power in Nepal and Bihar. The estimated cost, including the benefits to Nepal, is about Rs. 52 crores, out of which Bihar's share is about Rs. 41 crores. Preliminary works, such as construction of access road, camp buildings, procurement of machinery and erection of power house are in progress. The work of canal excavation has also started at a number of places in Champaran District.

Sone barrage project

The anicut across the River Sone at Dehri was constructed during 1874-78 and is now in a precarious condition. Under similar circumstances, the Krishna Anicut in Andhra Pradesh failed a few years ago, which threatened about 700,000 acres of paddy which is being irrigated from the anicut. The construction of a new barrage at Inderpuri, about five miles upstream of Dehri, is proposed at an estimated cost of Rs. 12 crores, including the cost of construction of two link canals. For remodelling the existing Sone Canal system, a sum of Rs. 2.5 crores has been sanctioned. Preliminary work for the construction of the new barrage has started, and the project is likely to be completed during the Third Plan period. On completion of the high level canals, this system will irrigate about 1,300,000 acres, against the present irrigated area of about 740,000 acres.

Other medium irrigation projects

Beside the above major projects, several medium irrigation projects like the Kamla Barrage in Darbhanga District, the Badua Reservoir in Monghyr District, the Kanchi irrigation scheme in Ranchi District, and the Roro irrigation scheme in Chaibasa District are being planned. In the Third Plan, it is proposed to take up the construction of the Gumani Reservoir in Santhal Parganas District, the Chandan Reservoir project in Bhagalpur District, and the Mohane Reservoir in Hazaribagh and Gaya Districts.

Power

Prior to independence, the activities of the State Electricity Department (now the State Electricity Board) were limited to issuing licences to private companies for generation and distribution of power in towns and for maintenance of electrical installation in the Government buildings. During the First and Second Plan periods, the activities of this Department were centred round transmission of power obtained from the Damodar Valley Corporation to towns and villages. During this period, the Department also constructed a number of pilot Diesel generating stations.

Recently, a thermal power station has been sanctioned at Barauni at an estimated cost of Rs. 3 crores for generating 30 MW of power. The work on this power station is expected to be completed by March 1962.

During the Second Plan, it was decided to electrify the Grand Chord line from Asansol to Moghulsarai *via* Gaya and from Asansol to Rourkela *via* Noamundi. The State Electricity Board is executing a programme of construction of 300 miles of 132 kV transmission line and three substations at a cost of Rs. 4 crores, for supply to the railways. Out of this, approximately Rs. 3 crores are expected to be spent during the Second Plan period. The Government of India and the Governments of Bihar and West Bengal have also sanctioned the installation of a steam power station consisting of two 140 MW generating units at Chandrapura in Bihar, primarily for meeting the power requirements of the railway electrification scheme and the additional demand for power in Bihar.

During the Third Plan, the Board will construct a steam power station of 100 MW capacity near Ranchi for meeting the requirements of power for the Heavy Engineering Corporation. The total capacity of the Barauni thermal station is proposed to be augmented by 15 MW, thus bringing its capacity to 105 MW at the end of the Third Plan. Another steam power station with an installed capacity of 350 MW is proposed to be constructed at Patratu in Hazaribagh District.

Besides, the Board proposes to construct a hydro-electric power station under the Gandak project with an installed capacity of 15 MW and another station under the Kosi project with an installed capacity of 10 MW for meeting the power demands of north Bihar and Nepal.

By the end of the Third Plan, construction of about 325 miles of 132 kV transmission lines in north Bihar and 255 miles in south Bihar is likely to be completed. About 2,600 villages are likely to be electrified, bringing the total number of electrified villages to 4,650 by March 1966, out of a total of about 70,000 villages in Bihar.

Communications

In 1947, the State had 897 miles of metalled and 418 miles of unmetalled roads. By the end of 1961, there will be 5,300 miles of metalled and 2,646 miles of unmetalled roads. This 513% increase during the last 13 years is an achievement of which the Public Works Department can be proud of. During the Third Plan, the Department proposes to construct about 2,000 miles of metalled and 400 miles of unmetalled roads for further improvement of communications in the State.

It is also proposed to construct a bridge across the River Ganga near Patna, for which investigations are being carried out.

Prior to independence, the Department spent about Rs. 33 lakhs on the construction of buildings. During the First Plan, the expenditure on building construction increased to about Rs. 10 crores, and in the Second Plan it is likely to be Rs. 12 crores.

Public health

During the First and Second Plan periods, 22 water supply schemes were taken up for execution in urban areas of the State, including the scheme for water supply to Heavy Engineering Corporation at Ranchi. After completion of these schemes, about 75% of the total urban population will be provided with fresh drinking water. This will serve all the towns with a population of 25,000 or more, except Jamalpur.

No sewage or underground drainage scheme was taken up in the First and Second Plan periods. In the Third Plan, therefore, provision has been made for underground drainage scheme in the towns of Muzaffarpur, Gaya and Ranchi. In addition, it is proposed to extend water supply to towns with population of 15,000 to 20,000.

About 10% of the total rural population in the State has been supplied with safe drinking water by the construction of piped water supply schemes. Out of the 70,000 villages in the State, about 45,000 have been provided with 22,000 tubewells with hand pumps.

Bihar is fortunate in having resources such as coal, iron ore, pyrites, manganese and aluminium ores. Before independence, the development of these resources was through private sector, mainly because the generation of power was in the private sector. After independence, the generation and transmission of large scale power and the basic industries were transferred to the public sector. In pursuance of this policy, steel plants have been established at Rourkela, Durgapur and Bhilai. Another steel plant is to be established at Bokaro during the Third Plan. Simultaneously, large scale expansion has been carried out in Tisco and the Indian Iron and Steel Works at Burnpur. The establishment of an oil refinery at Barauni has been decided. It is likely that a plant for producing sulphur and sulphur products will be established near Amjhore in Shahabad District, where large deposits of pyrites have been found. At Ranchi, the Heavy Engineering Corporation is erecting a foundry forge plant and a plant for manufacturing heavy machinery.

The existing superphosphate factory at Sindri will be expanded during the Third Plan. A new high tension insulator factory is also to be established. The Plan provision for establishing of large and medium scale industries in the State is of the order of Rs. 5 crores and for the village and small scale industries, Rs. 15.25 crores.

Technical education

There are four degree colleges in Bihar, at Patna, Muzaffarpur, Sindri and Ranchi. Recently, a regional degree college has been established at Jamshedpur.

Another degree college is likely to be established at Bhagalpur. It is, however, unfortunate that facilities for post-graduate training in engineering are not yet available in the State. It is felt that if all the technical colleges are brought under one technical university with facilities for post-graduate training, there will be uniform standard of teaching and examination which will yield better results.

In order to improve the standard of teaching in technical institutions, it is suggested that working engineers may be invited in large numbers to deliver lectures in technical institutions. It will also be helpful if there is a regular flow of engineers from the field to the technical institutions and *vice versa*, which will be beneficial not only to the students but also to the working engineers.

Research station

An engineering research laboratory has been established at Khagaul. All problems of soil investigation, river training, etc. can be referred to this laboratory for solution. It undertakes research in the design of mixes of concrete including use of puzzolan and air-entraining agents. I appeal to the Government to expand this laboratory in the field of hydrology and hydraulic model study.

Service conditions

The conditions of service for engineering personnel are generally better in the private sector than in the public sector. In order to improve the service conditions in the public sector, it is suggested that the cadre of All-India Service of Engineers be revived on the same lines as the I.A.S. and I.P.S. The workers in the field of research should be given additional incentive in the form of special pay, free house, etc. Frequent transfer of personnel is a great impediment in the field of research.

It has been often said that success and failure of an engineering project will depend on the ability and reliability of engineers and, therefore, to give the engineer his rightful place is important. I consider that it is for the engineers to forge their way to their rightful place. Instances are not rare in this direction. Sir M. Visvesvaraya forged his way to his rightful place. Dr. A. N. Khosla, by his technical and administrative ability, is now a member of the Planning Commission. Shri Kanwar Sain is the Chief Administrator of the Rajasthan Canal project. There should, therefore, be no bar for an engineer to be an administrator. I would, however, suggest that initially engineering graduates should be given administrative training, so that with experience they not only become good engineers but also good administrators.

Let us not forget that we have an important role to play in the development of our country. This requires unstinted effort and indefatigable energy and devotion to work. At times, we may have to sacrifice our personal comforts for better performance of our duty. But these are sacrifices which we must make willingly for the progress of the work entrusted to us. We should take up all such works in a spirit of dedication and see that they are completed in the best manner possible in the shortest time.

At no time in the history of our country has such an opportunity come, when engineers have to contribute so much for the development and prosperity of the nation. I would, therefore, humbly urge to everyone of you to look upon your work as a great privilege and opportunity for sanctified service to the State and country. I cannot do better than quote the words of our Prime Minister, 'Let us think not so much of what we have done, but what we have left undone. Let us think also of the mighty resources of India, which, if harnessed and utilized for common good, can change the face of India and make her great and prosperous. To this great task, let us address ourselves with all the strength in us.'

Madhya Pradesh Centre

Chairman's address by Shri S. S. Swaminathan, B.E., M.I.E., at the 2nd Annual General Meeting of the Centre on January 8, 1961.

The Chairman welcomed the Chief Guest, Shri S. N. Mehta, Chairman, M.P. Electricity Board, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1960-61.

During his address. Shri Swaminathan briefly described the development of the Centre since its inception two years ago, and said, 'According to its Royal Charter, the Institution aims to promote the advancement of engineering science and its application in India and to facilitate the exchange of information and ideas on engineering subjects amongst its members. An important link in this chain is the work of the Local Centres and Sub-Centres. The meetings and discussions organized by these Centres are devoted to the implementation of the objectives of the Institution. Much has been done to add to the status of the Institution, but a good deal more is required than mere dissemination of information among the members and promotion of the science of engineering. It is the creative effort of individuals which matters in this direction and each one of us has a personal responsibility to ensure that his contribution is adequate in all respects. The fact that the total contribution is satisfactory is reflected in the eminent position held by the Institution, but the contribution comprises strenuous efforts by a relatively small number of members, and I would request each of you to consider whether your individual contribution to the Institution and the development of the science you practice is as great as it should be. We must make the Institution a reservoir of knowledge to which we can look for guidance in times of need. This is possible only if the practising engineer contributes technical papers on investigation and design, technical problems encountered and the solutions proposed, and initiate discussions on these subjects. I hope that in spite of the additional strain involved, you will be able to devote more time to promote the cause of the Institution.

This is the age of advancement on all fronts of applied science. Nations are acutely conscious of the need to harness their man power and material resources effectively in the struggle to improve their standard of living. A good deal has been said regarding the urgent need for an increase in the number of adequately trained engineers and technical personnel. The Institution provides opportunities for technicians and overseers to acquire engineering qualifications by conducting Associate Membership examinations twice a year. The Madhya Pradesh Centre conducts special classes for Students attached to the Centre. That the number of Students attached to the Centre has doubled since its inauguration is sufficient proof of the popularity of these classes and the contribution of the Centre towards solving the problem of technical personnel.

Technical education occupies a pivotal position in the plan for national development. To improve the standard of education in engineering colleges and to give it a practical bias, it may be worthwhile transferring the services of suitable working engineers for a few years to technical colleges. It will also provide them an opportunity to refresh their knowledge. Similarly, if teachers are taken for field service for a few years, they will get a better knowledge of practical work, and they can impart this knowledge to the students. Industry must be willing to accept, encourage and assist such transfer of staff as a means of ensuring an augmented supply of candidates of high quality. All engineering colleges should also function as research centres to which problems of the practising engineer may be referred to.

One of the important aids to the growth of engineering profession is a good technical library. It is needless to emphasize the necessity of a well equipped library at each Centre. We have not been able to develop our library for want of finance and accommodation. The need for a building for the Centre to enable the members to meet, exchange their views, solve their problems, and to house a good technical library is being keenly felt. I earnestly appeal to all members attached to the Centre to make an effort to raise funds for the building. I take this opportunity of appealing to the Government of Madhya Pradesh for help and encouragement to the Centre in constructing its own habitat, building up its library, and carrying out the work of the Institution in the State.

The different aspects of the work of the Institution are truly represented among its 30,000 members. With such vast resources of both theoretical and practical knowledge, we are confident of being able to give sound advice on any particular engineering problem. This fact is being appreciated by some State Governments and industries who are consulting the Local Centres on technical matters.

In the engineering world of today, civil engineering is playing a role of ever increasing importance. For example, the gas engineer has problems in the construction of foundations, superstructures, gas chambers, elevators, coal bunkers, and a host of other structures which are related to production and distribution of gas. Likewise, the electrical engineer cannot function without a power station building, cooling towers, and bases for heavy machinery, all of which directly concern the civil engineer. Aircraft must have aerodromes, hangars, and service buildings. Ships, apart from the fact that each vessel is a structure in itself, must have shipyards, docks, harbours, wharves, lighthouses and anchorages. No modern railway system can exist without bridges and stations, warehouses, engine shops, repair shops, etc. The mining industry depends essentially on efficient pithead gear, bunker and handling facilities. In every case, the work of the civil engineer is involved in some way or other.

With the growth of industry and improvement in the standard of living, more water is in demand. In the harnessing of natural supplies of water, both surface and underground, an expert knowledge of civil engineering is essential. The design and construction of reservoirs, hydro-electric schemes, dams, control gates, power stations, pump houses, etc., are sufficient examples to stress the importance and all embracing necessity for the work of the civil engineer.

I shall now follow the usual practice of dealing with the branch of engineering with which the Chairman is connected, and speak about the civil engineering works in power generation, which has been the field of my work.

In our State, most of the electricity comes from thermal power stations using conventional fuels. The trend towards larger generating sets, higher steam pressures and temperatures, and the use of improved techniques, have contributed to substantial economies in both capital investment and operating costs. Hydrogen cooling of alternators has reduced the losses and made higher capacity machines possible. There has been a corresponding increase in the boiler sizes. Pulverized fuel firing is rapidly superseding chain grate stoker firing because it is the only practical method of burning low grade coal which is almost the only type now available for electricity generation. In our State, we started with 10 MW sets at Kaperkheda, 30 MW sets were later installed at Korba, and the new stations (Amarkantak, Satpura and Korba expansion) have been planned for 50 MW sets and pulverized fuel firing.

The water power resources of the State are unlimited. The power potential of the rivers in the State has been estimated at over 3,700 MW. The possibilities of the Punasa, Indravati and Narbada basins are estimated at 970, 1,243 and 970 MW respectively. No serious attempt has so far been made to investigate and develop these water power resources, but it is gratifying to note that an allocation of Rs. 1 crore has been made by the State Government in the Third Plan for investigation of hydro-electric schemes.

I must also include a reference to nuclear power generation in which the physicist, the chemist, the engineer and the metallurgist working together have succeeded in developing an entirely new source of energy which may ultimately supplant all other sources. In this sphere also, India is not lagging behind. The Third Plan will see the second nuclear station at Tarapore being commissioned. The advent of nuclear power has brought a new type of power plant building, the containment vessel. The considerations involved in locating such a plant are more complex than those required for a normal power plant. The planning, design and construction of such a power station calls for specialized civil engineering.

The economy of operating nuclear stations at high load factor makes pumped storage schemes attractive. Under such schemes, water can be pumped up into a reservoir during night, when spare power is available in the system. During day, this water can be used to produce useful power.

What steam temperature and pressure are to the turbine engineer, voltage is to the transmission engineer. There is an almost continuous progress towards higher voltages associated with the growth in distance of transmission and generation capacity. The M.P. Electricity Board has planned the establishment of a 132 kV grid connecting all major power stations. Transmission lines operating at 400 kV are in operation in Sweden, the U.S.S.R., Germany and France where the transmission distances and electrical loads make such high voltages economical. Still higher voltages are under consideration for main trunk lines in the U.S.S.R. and the U.S.A. Before long, we shall be having trunk lines at high voltages in India also, connecting the main generating stations. In the fields of generation and transmission also, the civil engineer has a prominent part to play.

Planning for a large thermal station includes site investigations, collection of necessary data, layout, and design and construction involving considerable amount of civil engineering work which calls for specialized knowledge and experience in hydraulic, geological and structural spheres. The designer, in selecting the fabric of a structure and its form, will be influenced by the following considerations: (i) function of the structure; (ii) material most suitable for the fabric; (iii) availability of material; (iv) site conditions; (v) expectation of life; and (vi) cost limitations.

The science of soil mechanics has made such advances that investigation of site conditions makes more accurate data available than was hitherto possible, to enable a decision to be made regarding the most suitable type of foundation. At this stage, close cooperation is essential between the designer and the soil-mechanics investigator regarding the form, size and depth of foundation. Since this part of a structure cannot be inspected periodically, the importance of sound design needs no emphasis. Undue settlement or failure of a foundation is very costly to remedy afterwards.

It should be the object of every power station building designer to provide as much space as possible at minimum cost per kW installed. Many factors have to be considered in planning of a power station such as the length and run of cables, layout of circulating water pipes, disposition of turbo-generators and boilers, and their individual and combined effect on the plan, elevation and section of the building. The building requiring the least amount of steel or concrete per c.ft. or per kW installed is not necessarily the most economic when viewed in the light of the total cost of the station. The volume occupied by the building is controlled by the arrangement and size of the plant to be used, though it should be the designer's aim to provide a volume consistent with easy operation.

In general, there are three factors which influence the planning and construction of large thermal power station projects: (i) consideration of constructional features, (ii) quantities of construction and erection materials involved, and (iii) the time schedule for civil engineering and erection works. The close interdependance of these factors makes their equal and constant consideration imperative. A rigid time schedule for all operations, from the preparation of specifications to the installation and commissioning of the plant, has to be prepared initially to ensure that nothing is lost sight of.

The quantity of materials required needs careful consideration. The procurement of materials, and storage and maintenance of adequate working stocks is of vital importance. The volume of constructional materials required constitutes a determining factor in arranging for the prerequisites at the site. For example, large quantities of rolled steel sections, cement, reinforcement steel, asbestos cement sheets, and pipes have to be made available at site. The total as well as current quarterly requirements will have to be calculated and arranged for, with due regard to the scheduled progress of civil engineering works.

Fixing of target dates for the completion of civil engineering works requires preparation of an overall time schedule for the entire project. However, this is possible only after the orders for the supply and erection of the major items of plant have been fully awarded. Efforts to meet the deadlines necessitate the recurrent preparation of sub-schedules and current assessment of all target dates. The actual construction progress has to be continuously supervised and checked for conformity to the time schedule.

The success of civil engineering works depends upon design and working drawings, coordinated in respect of all details. Translation of the designs into practice is a complicated problem which requires considerable skill and experience in order to organize the works in compliance with the time schedules.

The constant adjustment of civil engineering works to the requirements of progressive erection is of primary significance. The data required for the preparation of detailed drawings for the foundations are supplied by the main plant contractors, after the designs for the plant and equipment are completed in all respects. In addition, the process of tendering and other formalities connected with award of contracts are time consuming so that there is relatively small time interval between the commencement and completion of the work in general and foundations in particular. These provisions place an unusually heavy burden on the site staff. The situation requires planned programming and coordination with all agencies and departments connected with the work.

A number of thermal power stations have been planned, designed and constructed by the M.P. Electricity Board prior to the States' reorganization. The Kaperkheda power station of 30 MW capacity was designed and constructed with the help of consulting engineers, whereas the power stations at Ballarshah (22,500 kW), Itarsi (2,500 kW), Chandani (17,500 kW), Korba (90,000 kW), and Bhopal extension (500 kW) have been designed and constructed by the Board. The 90 MW Korba generating station is the first large power station in the construction programme of the M.P. Electricity Board to be brought into commercial operation. During the Third Plan, three large thermal stations have been planned, 60 MW Amarkantak thermal station in Shahdol District, 150 MW Satpura thermal station in Betul District, and 200 MW extension to the Korba thermal station. A novel feature of these stations is the use of lake cooling in preference to the conventional cooling tower system for cooling of the circulating water. In spite of the higher initial cost, it has been found to lead to considerable savings in operation costs as a large block of auxiliary power used for fans in cooling towers becomes available for being fed into the system.

The newly constituted State of Madhya Pradesh offers considerable scope for the development of power potential and natural resources. A vast hinterland of mineral resources offers itself for exploitation. This can only be achieved when power is available. The rivers in the State have a large hydro-electric power potential. It is, therefore, essential that an organization should be set up for investigation and exploitation of mineral resources and also for investigation, design and implementation of hydro-electric schemes. In the case of a basic industry like electric power, whose output is the input of other industries, planning has to be more dynamic than in other industries.

All branches of engineering are becoming more specialized and in a sense more precise or scientific. With all the modern tools and techniques, the art and craft of the engineer are still needed to produce good engineering results. It might be said that engineering achievement is conceived in art, nurtured on science, and justified by economics. An engineer has not only to make his project work but he has to make it pay. It is easy for the designer and planner to make things so large or so strong that they will never fail but it is much more difficult to make them just so large or just so strong that they will give the required performance at minimum cost. Half the art of engineering lies in perceiving the most economic performance and providing what is required, not and just the best.

Sir Winston Churchill in one of his addresses to the nation said 'Give us the tools and we will finish the job'. Today, tools may be interpreted as money, men, materials and trust. Given these tools, there exists no doubt that engineers can and will finish any job with credit to themselves and to the lasting benefit of the communities they have the honour to serve.

'Service before self' should be our motto and the advancement of the nation should be considered the reward.'

Summaries of Papers Published in the Journal, vol. 42, no. 1, pts. CI 1, ME 1 and ET 1, September 1961

CIVIL ENGINEERING DIVISION

Some Aspects of Real Property Valuation for Estate Duty

B. N. Chaudhuri

Member

In all valuation work, the first important thing to be ascertained is the purpose for which the valuation is required. The principles on which valuations are based for the purpose of sale, purchase, mortgage and rating are, more or less, well defined in text-books on valuation. Introduction of the Estate Duty Act of 1953 in India has widened the scope of the work of a valuer, and the responsibility that has been vested on the valuer for this work is onerous. The valuer has dual responsibility—firstly to his country, which benefits directly or indirectly from the tax levied on an estate when it passes from one generation to other; and secondly, to the person who inherits the estate and has to pay the tax out of the benefits therefrom. The principal function of the valuer there is to weigh very carefully the benefit the heir would derive from the estate and base his valuation accordingly. To weigh this benefit, the valuer has to understand the real implication behind this legislation. In a welfare State, the Government attempts to augment the resources of the Exchequer from the wealth produced by an individual for the common weal. In the Estate Duty Act, attempts have been made to share the wealth accumulated at one point of time, and appropriate it for the development of the welfare State. Some of the basic problems of valuation for Estate Duty have been outlined in the paper.

Density Currents in Reservoirs and Their Simulation in Models

D. V. Joglekar
Member

The paper describes briefly the density currents that were found to occur in Lake Mead above the Hoover Dam (previously known as Boulder Dam). Density currents move along the bottom of the reservoir, near the surface or at intermediate depth depending upon the temperature, salt content, and the quantity of suspended load. In practical system operation, density current flows are important to industrial water use, stream pollution, recreation, municipal water supply, and steam plant condensing water. The paper describes in detail an interesting example of how cold water underflow current was diverted to the Kingston Steam Plant, U.S.A., near the junction of the Emory and Clinch Rivers downstream of T.V.A.'s Norris Reservoir, some 78 miles upstream. There was close conformity in the model and the prototype behaviour. Model studies on density currents at the Iowa Institute of Hydraulic Research and on submerged sluice control of stratified flow at the Massachusetts Institute of Technology, U.S.A., are described briefly. At the end of the paper is given a summary of papers on density currents, which were discussed in the 8th Congress of the International Association for Hydraulic Research held at Montreal, Canada, in August 1959.

Some Conceptions on Water Supply Engineering Design

G. R. Kulkarni
Associate Member

Due to the growing developmental activities in recent years, small towns and villages are clamouring for piped water supply schemes. Some problems in designing the components of such schemes are discussed in this paper. Prospecting of population and the rate of water supply per capita per day form the nucleus of such designs. These factors are sometimes not fully understood and in consequence result in under-design, *i.e.*, schemes falling short of the actual needs.

To keep down the initial capital cost, there is a tendency to compare the efficiency of a design by providing smaller capacity units. This is bad economy and has to be avoided in long term planning of water supply schemes. The best design is that which brings in economy at a law capital cost without impairing the efficiency, including the future liabilities valued at present day costs.

Edge Disturbance in Circular Cylindrical Shells

S. K. Mallick

Non-member

The analysis of shells forms a major problem in engineering design. Considerable work has been done during the last 30 years to present the theory in a compact and simplified form for ready application to design problems. These developments have been reviewed by McNamee and Jenssen and are well known.

In this paper, Holland's new approach for the computation of edge disturbances is briefly presented and illustrated by an example. The solutions are compared with those obtained by another method.

The preliminary stages, *i.e.*, expressing the forces, moments displacements, etc. in terms of a single variable, are elementary and not given here. The differential equation as it follows from Flugge's equations is stated, and the various stages thereafter for computing the edge disturbances are presented in detail. The scope of this paper is limited to disturbances from straight edges only.

Blending of Aggregates

N. K. Vaswani

Associate Member

The necessity of blending aggregates for cement concrete, bituminous concrete, and soil stabilization has been discussed. Some useful methods of blending aggregates obtained from different quarries to achieve the required grading are explained by means of examples. The methods discussed include (i) method of approximation in combination with trial and error, (ii) graphical method of sieves, (iii) Rothfuch's graphical method, and (iv) Triaxial method. The utility of each method depending upon the data supplied and type of mix required are also discussed.

MECHANICAL ENGINEERING DIVISION

Calculating of Time on Shaping, Slotting and Planning Machines

S. K. Bhattacharyya

Associate Member

In machine operations, as in the case of shaping, slotting and planning machines, there is considerable waste of time in the return strokes with no cutting action, and the cutting speed is also not continuous. The speed-feed factor which varies with the machine, material, operation, surface finish, etc., and influences the machining time per stroke per in. width in the above operations will have to be established by means of a series of actual machining operations under different conditions. For standardizing the time of machining, certain allowances become necessary so that the rate fixer is able to visualize the machine operators, approach to the job and provide the necessary chance for the latter to use his judgement and skill to his benefit. With this background, the paper presents a series of tables for the several aspects of shaping, slotting and planning operations to facilitate ready reference in such jobs.

A Study of Journal Bearing—3

H. M. Ganesh Rao

Associate Member

In the two earlier parts of the paper (*Journal*, vol. 40, no. 5, pt. 2, January 1960, and vol. 40, no. 7, pt. 2, March 1960), the temperature distribution along the circumference of a journal bearing was evaluated in terms of θ for an incompressible lubricant with (i) constant viscosity, and (ii) viscosity varying with temperature and pressure. In this third part, the evaluation of temperature distribution and load is attempted in the case of a journal bearing using a compressible lubricant.

Cheap Insulation Material for Cold Storages and Household Air-Conditioning

R. N. Mehra

Associate Member

Though there are many insulating materials such as cork, mica, thermocole, etc. which are suitable for thermal insulation in cold storages and residential and other buildings, due to their prohibitive cost and the difficulty in importing them, need has arisen to find out alternative materials. As a result of research work carried out in the Buildings and Roads Research Laboratory of the Punjab Government, the use of cement-sawdust blocks gave encouraging results in the case of some cold storages but not in the case of buildings. Tests made in the Mechanical Engineering Research Laboratory of the Punjab Engineering College, Chandigarh, to find out some cheaper and effective insulation material indicated the use of waste wood after its conversion into sheets, blocks or powder according to the requirement of each job. This paper describes the conversion of waste wood into pulp and the casting of pulp blocks and sheets.

Construction of Electric Overhead Travelling Cranes

A. N. Naik

Associate Member

In the present day construction and maintenance jobs, there is more and more of articulation and integration of the various operations, especially in heavy industries. The result of the breakdown of a unit severely and adversely affects the whole line of production. In industrial establishments where a large number of electric overhead travelling cranes are installed, the erection or maintenance of such equipment, especially in a running mill, presents extremely difficult problems to engineers. It is therefore essential that such works have facilities which afford expediency and efficiency in their execution. From personal experience in the erection and maintenance of heavy E.O.T. cranes of various types under difficult situations, the author explains some methods of tackling the intricate problems that are encountered in heavy engineering shops and industries where cranes, gantries, and other lifting devices form the lifeline of production.

ELECTRONICS & TELECOMMUNICATION DIVISION

Fading of Short Wave Radio Signals at Vertical Incidence and Its Bearing on the Drift in the Ionosphere

S. S. Banerjee

Non-member

and

S. C. Chakravarty

Non-member

It is known that the fading characteristics of short wave radio signals reflected from the ionosphere may depend on the drifts appearing in those regions of the upper atmosphere. It was therefore thought useful to study the relation between them. The paper describes the results of observations made in the laboratory in connection with the fading patterns and the wind velocity resulting from drifts in the ionosphere.

Impedance of a Composite Waveguide

S. K. Chatterjee

Non-member

and

(Sm.) R. Chatterjee

Non-member

In the first part of the paper, expressions for the power flow in a circularly cylindrical hollow waveguide filled with two different dielectrics and excited in the H, E and HE modes are derived by using the Poynting vector and field components. The impedance relations for such a composite guide are deduced from the

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expressions for power flow for all the three above modes. The dielectrics inside the waveguide are assumed to be lossless.

In the second part, the power flow in a surface waveguide in the form of a single wire surrounded coaxially by a lossless solid dielectric and excited by H_1, E_1 and HE_1 waves has been calculated. From the expressions for the power flow, the transverse impedance of the guide excited by the above three modes has also been calculated.

Power Patterns of a Microwave Paraboloidal Radiator on an Average Test Site

N. K. Dey
Non-member
and
A. P. Kulshreshtha
Non-member

The power patterns of a radiating system are obtained from the observations of received power at a large distance from the radiating system so that it may be assumed to be a point source, and the patterns may be independent of the distance from the radiating system. This region is known as the 'Fraunhofer' region. In the case of a microwave paraboloidal reflector used as the radiating system, the distance of the Fraunhofer region depends on the aperture of the reflector. Also, the Fraunhofer region begins from a distance from the aperture. With proper design and dimensions of the paraboloid and the feeding system, the power patterns may be obtained at a much shorter distance. Observations on the power patterns are recorded in this paper with a single dipole at the focus of the paraboloid, and also with an Yagi array feeder.

Design Procedure for Very Wide Band Distributed Amplifiers

S. C. Nath
Non-member

In a distributed amplifier, plate and grid of individual tubes are connected to two transmission lines at suitable points such that their capacitances to ground form, wholly or in part, the shunt capacities of the two respective lines. Apart from a voltage gain between input and output, the distributed amplifier is essentially a lumped constant transmission line, which is made up of low pass filter sections in cascade, each having probably a definite loss factor. The amplitude, therefore, cannot respond beyond the cutoff frequency of any of these lines. Further, it can be shown that gain at higher frequencies cannot be improved upon in the same scale as the gain at lower frequencies simply by increasing the number of tubes in the chain. Actually, by increasing the band width of individual sections of the lines and number of tubes beyond a certain limit, the overall band width of the amplifier is reduced. Thus, from the standpoint of wide band amplification, a critical understanding of the involved loss factors, which cannot be neglected under conditions of very wide band amplifications, is very essential before one can proceed to a suitable design procedure for a distributed amplifier.

INSTITUTION NOTICE

Symposium on 'Economy and Efficiency of Engineering Enterprise in India', New Delhi, November 12-13, 1961

The Council have decided to combine the two Symposia, announced on page 13 of the *Bulletin*, vol. 10, no. 10, June 1961, into one Symposium on 'Economy and Efficiency of Engineering Enterprise in India', which will now be held in New Delhi on November 12 and 13, 1961. The Symposium will be inaugurated by Shri Lal Bahadur Shastri, Minister for Home Affairs, Government of India. It is hoped that members will attend the Symposium in large numbers and make it a success.

Draft Indian Standard

The following draft Indian Standard has been issued recently.

1. Draft Indian Standard Code for Designation of Pig Iron and Ferro Alloys—Dec: SMDC 1 (259).

This Standard codifies the symbols which may be used for designating pig iron and ferro alloys on the basis of chemical composition.

Members may send their comments on the above draft Standard before October 25, 1961, to Dr. D. R. Malhotra (*M.*), Golf Course Road, Ajmer, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; or 2/21 First Line Beach, Madras 1.

FORTHCOMING CONFERENCES

ECAFE Regional Seminar on Energy Resources and Electric Power Development, Bangkok, December 6-16, 1961

The ECAFE Regional Seminar on Energy Resources and Electric Power Development will be held in Bangkok from December 6-16, 1961. The purpose of the Seminar is to enable engineers, economists and administrators to discuss and review the problems faced and solutions obtained in the development of energy resources.

Further details regarding the Seminar can be had from the Chief Electric Power Section, United Nations ECAFE, Bangkok, Thailand.

International Television Conference, London, May 31 to June 7, 1962

An International Television Conference is being organized by the Electronics and Communications Section of the Institution of Electrical Engineers, London, to be held in London from May 31 to June 7, 1962. The Conference will cover the scientific and engineering aspects of television, including programme engineering, transmission, reception, standards, colour, industrial and educational television, pay television, links and relay including the use of communication satellites, etc.

Further information regarding the Conference can be had from the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

BOOK ACKNOWLEDGMENTS

1. **Experimental Building Craft Science.** C. R. Bassett. *Cleaver-Hume Press Ltd.* 133 pages.

This book presents a collection of experiments with explanations in the subject of building science. It is based on the syllabus for the City and Guilds of London Institute Craft Certificate examination, and covers the basic principles of various aspects of building construction including determination of properties of the following building materials : cement, concrete, lime, clay and timber.

2. **Computer Analysis of Cylindrical Shells.** J. E. Gibson. *E. & F. N. Spon Ltd.*, 84 s. 259 pages.

This book is intended to supplement the theory of computation of cylindrical shells, and includes results of computer analysis of a large number of shell roofs to assist in design of standard shells where computer facilities are not available and to act as a design guide where such facilities are available. It covers single shells with edge beams, multi-shells with edge beams, and multi-shells with prestressed edge-beams.

3. **Theory of Hydrodynamic Lubrication.** O. Pinkus and B. Sternlicht, *McGraw-Hill Book Co., Inc.*, $ 15.00. 465 pages.

This book presents differential equations to explain the theory of hydrodynamic lubrication, including energy and elasticity considerations ; techniques of solving these equations either analytically or by means of analogue and digital computers ; and solutions of these equations, to aid in design of bearings and solution of specific bearing problems.

4. **Elementary Machine Shop Inspection.** R. C. Tatlow. *Blackie & Son Ltd.*, 9 s. 127 pages.

This book deals with the basic methods and tools of engineering inspection frequently required in machine shops of precision engineering works, including brief descriptions of tools and gauges commonly used in such inspection work.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Shri Des Raj

Shri Des Raj, B.Sc.(Eng.), M.I.E., died in June 1961, at the age of 55.

After obtaining the B.Sc.(Eng.), degree from the Rangoon University in 1932, Shri Des Raj joined the Burma Public Works Department in Mandalay, where he was appointed Municipal Engineer in 1941. In 1942, he joined the Central Public Works Department at Bombay. He was promoted to Executive Engineer in 1945 and Superintending Engineer in 1945. During his professional career, Shri Des Raj was responsible for the construction and maintenance of runways in Bombay, and many residential and office buildings and hill roads in Himachal Pradesh.

Shri Des Raj joined the Institution as Associate Member in 1944, and was transferred to Member in 1958.

CORRIGENDA

TO VOL. 10, NO. 3, NOVEMBER 1960

Page 44. Revised List of Referees. Instead of '10. AM 2171 Madan Lal (C)', please read '10. M 2071 Madan Lal (C)'.

TO VOL. 10, NO. 8, APRIL 1961

Page 47. List of New Elections and Transfers. Instead of 'S 26653 Ajya Kumar Tewari', please read 'S 26653 Ajay Kumar Tewari'.

TO VOL. 10, NO. 11, JULY 1961

Page 15. 'Award of Shrimati Saroma Sanyal Memorial Prize'.

Instead of 'The Trustees of the Public Charitable Trust for the Advancement of Engineering Education have awarded the Shrimati Saroma Sanyal Memorial Prize for the Student passing Section B of the Associate Membership Examination in one attempt and securing the highest number of marks in the subject of Water Supply and Sanitary Engineering', to Sarvashri M. V. Suryaprakasam (*A.M.*) and Shri N. Majumdar (*A.M.*)' please read 'The Trustees of the Public Charitable Trust for the Advancement of Engineering Education have awarded the Shrimati Saroma Sanyal Memorial Prize to Sarvashri M. V. Suryaprakasam (*A.M.*) and N. Majumdar (*A.M.*) for their joint paper on 'A Critical Study of Septic Tank Performance in Rural Areas', published in the *Journal*, vol. 40, no. 12, pt. 1, August 1960'.

Page 38. List of New Elections and Transfers. Instead of 'S 28762 Laxmiprasad Vanamalidas Bhatt', please read 'S 28762 Laxmiprasad Vanmalidas Bhatt.'

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

INDUSTRIAL ADVISER, PRODUCTIVITY SPECIALIST, EXECUTIVE, highly qualified in electrical and industrial engineering with diversified experience in different industries and institutions. Has worked as industrial and management consultant in an international firm of consultants and advised many leading organizations in the private and public sectors, including Government. Is available for full/part time service on reasonable terms. (Office ref. E.S. 94).

YOUNG ELECTRICAL ENGINEER, passed Section A of the Associate Membership Examination of the Institution of Engineers (India) and appearing for Section B in November 1961, having about six years experience in installation, operation and maintenance of substation equipment in a large supply company and industrial equipment in a leading steel company, and holding independent charge of electrical department in a leading steel company, requires a change in Calcutta with good prospects. (Office ref. E.S. 95).

SITUATIONS VACANT

STUDENT members of the Institution of Engineers (India), having sharp intelligence, capable of hard work and interested in taking up industrial engineering and management as a profession may be successful in gaining an opportunity to work in a firm of industrial and management consultants in Calcutta under the guidance of a Chartered Engineer. Applications enclosing passport size photograph should be addressed to the Institution, giving full details of age, education, background, etc., and mentioning the names of two Referees and sent under cover superscribed 'INDUSTRIAL ENGINEERING AND MANAGEMENT TRAINING' so as to reach before November 30, 1961.

UNIVERSITY

THE BULLETIN

OF

The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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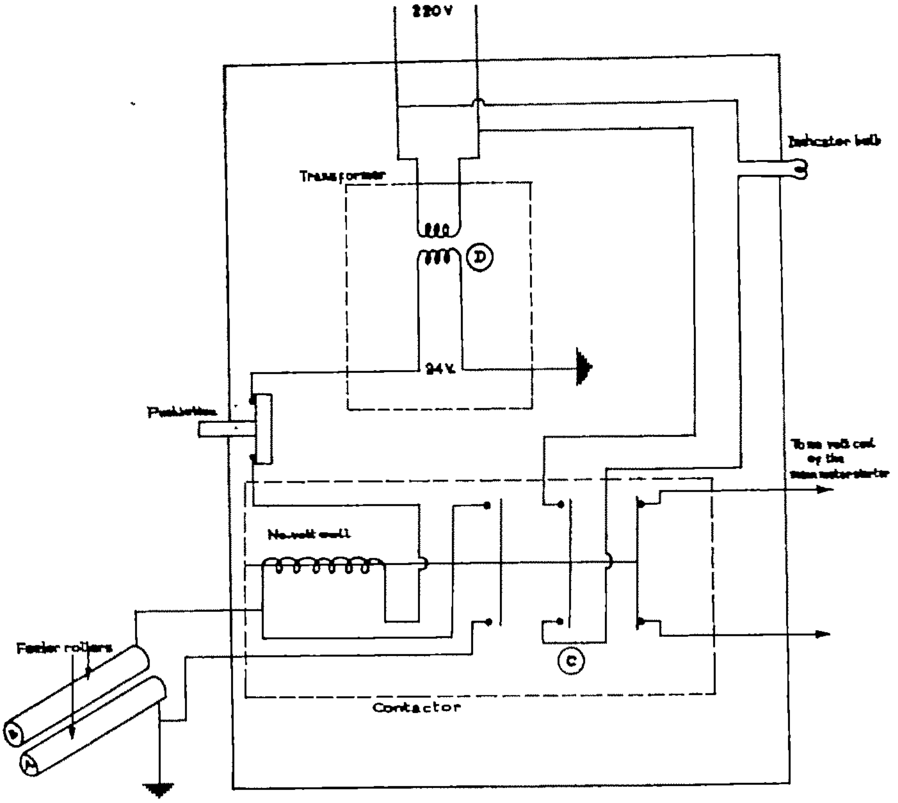
METAL DETECTOR FOR SHEARING AND CROPPING MACHINES

B. M. Bhatt
Member

A number of textile mills have installed shearing and cropping machines for removing the projecting fibres and loose ends before the cloth goes for processing. These machines mainly comprise four sets of cutting cylinders provided with spiral blades and stationary or ledger blades. Though grey cloth is usually inspected before it is fed to shearing cutters, it is often found that foreign bodies, such as pieces of picker, ring travellers, pirn bottom ring, teeth of weavers' iron comb, small nails, etc., which get interwoven in the cloth, pass on to the cutting cylinders and tend to damage both the spiral and stationary blades. Under the present circumstances, when it is difficult to procure spare blades, such damage results in stoppage of the cutter unit and consequent lowering of the standard of finish. Even when a spare blade is available, it usually takes a long time to grind it to proper cutting edge. Moreover, these blades are costly. It will, therefore, be advantageous if means could be found to prevent such damage. It is suggested that a metal detector be provided which will indicate and stop the machine as soon as a metallic body passes the cloth and before it enters the cutters. Such detectors are available in foreign markets, but with a little extra effort, it should be possible for any mill to manufacture and fit a detector. Basic principles of a detector are given in the following paragraphs.

On the feeding side of the shearing machine usually one mild steel bar tensioning device is provided which gives variable tension when the angle of inclination of the device is adjusted. The bar is either square or round in cross-section. The device is shown at A in the accompanying figure. Over this tension bar is another mild steel bar, B, about 4 ft. 6 in. long. The bar B is clamped to the bar A, but is kept insulated from it by presspahn paper. The clamping is done with springs to give slight flexibility between the two bars. One of the bars is earthed and a terminal is connected to the other. A contactor, C, with three 'make' and one 'break' contacts is provided. D is a 220/24 volts transformer. The no-volt coil of the contactor is wound for 24 volts. One terminal of the 24 volts side of the transformer is earthed and the other terminal is connected to the bar B through a push button and the no-volt coil of the contactor. The no-volt circuit of the contactor is completed whenever a piece of metal passes between the bars A and B. One terminal of the 220 volts circuit of the transformer is connected through one of the make contacts of the contactor to a red indicator bulb which lights when the contactor is on and indicates that a metal particle is between the bars. The no-volt coil of the main motor starter is connected through the break contact of the contactor, so that when the contactor is energized, the main motor trips simultaneously as the red indicator bulb lights. The distance between the bars A and B can be adjusted so that the metal particle is in contact with both the bars and yet the bars allow the particle to pass without tearing the cloth. The auxiliary circuit of the contactor is completed through its second make contact, and keeps the contactor in on position till it is put off by the push botton which is connected in



series with the no-volt coil. The indicating red lamp remains on and the main motor stops.

The contactor need not necessarily be of the three make and one break type, as shown in the figure. What is actually needed, however, is a two make and one break type contactor with a stepdown transformer of 220/18 to 24 volts.

The motor contactors consist of four make contacts, three for the motor circuit and one for the auxiliary circuit. These contactors can be utilized by converting one of the make contacts to a break contact. Relay contactors can also be used as these are provided with a break contact. (Make contact means the contact is normally off and break contact means it is normally on.)

Besides detecting metal particles, this arrangement prevents pieces of pickers, etc. from passing between the bars and tearing the cloth, though this tearing is preferable to damaging of the cutters which would result if these pieces move on to the cutters. While complete protection is not claimad by the device, the author has tried this contrivance on a Menschner shearing and cropping machine and achieved fairly good results.

Contemporary World Engineering Projects Series—16

Members are invited to contribute to this Series special articles featuring major engineering projects which they may have visited or with which they may have been associated in any other manner. Articles should be preferably accompanied by photographs and illustrative sketches.

WILLINGTON-A POWER STATION

General

The 400 MW semi-outdoor type Willington-A thermal generating station is situated between Derby and Burton near the East Midlands coalfields in England where the production of steam raising coal is high and cooling water is readily available from the River Trent. The station is of the unit design, *i.e.*, there is one boiler for each of the four 100 MW turbo alternators. The layout of the plant is in 'H' formation with four boilers grouped in facing pairs at the centre to form the cross leg of the 'H' and two turbines in line on each side. The plant control rooms are located between each pair of boiler/turbine units to give fully centralized control. The switchgear rooms are located centrally between each boiler and turbine to give short runs of instrument leads and cables to auxiliary plant. This layout resulted in a compact design giving an enclosed volume of about 19.5 c.ft. per kW installed.

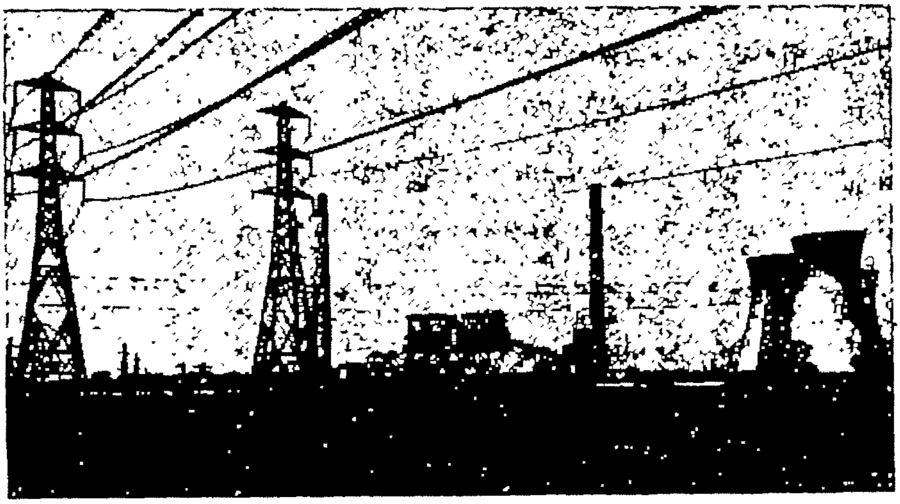


Fig. 1

General view of the Willington-A power station

Compiled from the publications made available by the courtesy of the Central Electricity Generating Board, London.

Foundations and building

The subsoil for the foundations of the various power station structures consists of river sand and gravel overlaying marl. Tests carried out on soil samples recovered from pre-constructional borings showed that the soil has bearing capacity of up to 3 tons per sq. ft. for gravel and 3½ tons per sq. ft. for marl.

To reduce stresses, the foundations were divided into a number of independent rafts by expansion joints which were so arranged as to isolate the heavily loaded areas. The heavy pulverizing mill and boiler foundations are of the cellular type, while the rafts for other foundations are of solid construction. Calculations indicated that the subsoil will consolidate under the foundation pressure by amounts varying from ¼ in. to a maximum of 1 in.

Foundations for the two 425 ft. high chimneys for the boilers consist of large octagonal reinforced concrete rafts founded on marl.

Coal handling plant

Coal is delivered to the station mainly by rail, and is transferred to the bunkers either from stock or wagon tipplers by means of conveyor belts (Fig. 3). From the tippler hoppers, coal is conveyed to the screening and crusher house. Between the tippler and the crusher house a probe type magnetic separator removes tramp iron. In the screening and crusher house, coal passes through one of the two selected routes. Deliveries of coal up to 2 in. size are screened and crushed before passing to the transfer hopper, but coal of up to ¾ in. bypasses the screen and crushers and is delivered direct to the transfer hopper. From this hopper, coal can be delivered to the store or to the station bunkers. For delivery to the store, it is conveyed to a boom stacker which forms an initial stock pile which is subsequently spread over the storage area

Fig. 2

Coal handling plant

with the help of bulldozers. Bulldozers are also employed to reclaim coal from the stores into any one of the reclaim hoppers, whence it is conveyed *via* the coal store junction tower, after magnetic separation, to the transfer hopper in the crusher house. Coal in the transfer hopper, delivered either from the tipplers or from the store, is conveyed to the station bunkers.

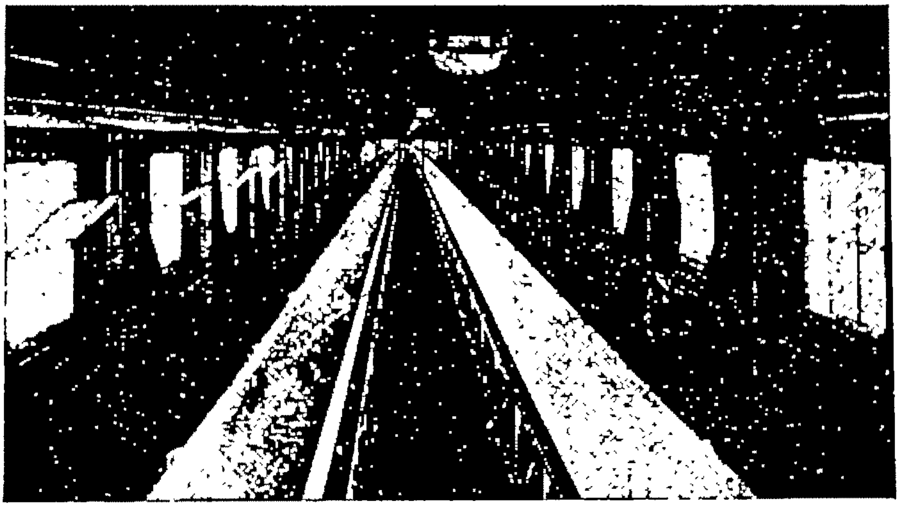


Fig. 3

Incoming coal conveyors

Boiler plant

The boilers are rated to produce 830,000 lb. of steam per hr. at 1,600 lb. per sq. in. pressure and 1,060°F. temperature. Each boiler is provided with four pulverized fuel mills (Fig. 4), each rated for 16 tons of fuel per hr. and is driven through reduction gearing by a 185 h.p., 3.3 kV induction motor. Three of these mills are capable of maintaining full load on the boiler. Both mechanical and electrolytic dust collectors are utilized to reduce pollution of the atmosphere to a minimum.

For normal firing, exhauster fans draw pulverized fuel/air mixture from the mills through the separator and deliver it to the 16 burners situated in banks of four at each corner of the boiler. The burners are arranged to provide tangential firing so as to produce a high degree of turbulence inside the combustion chamber. They can also be tilted up to 30° above or below horizontal for automatic control of the final steam temperature. In addition, oil firing equipment has been provided for starting and carrying up to 12% load.

Each boiler is a single-drum unit consisting of a radiant boiler, primary and secondary superheaters, economizers, rotary air heaters, forced and induced draft fans, pulverizing plant, automatic oil burning equipment, and mechanical and electrostatic dust extraction plant. Spray type attemperators are interposed between the primary and secondary superheaters, which, in conjunction with tilting pulverized fuel burners, control the final steam temperature to within ± 15°F.

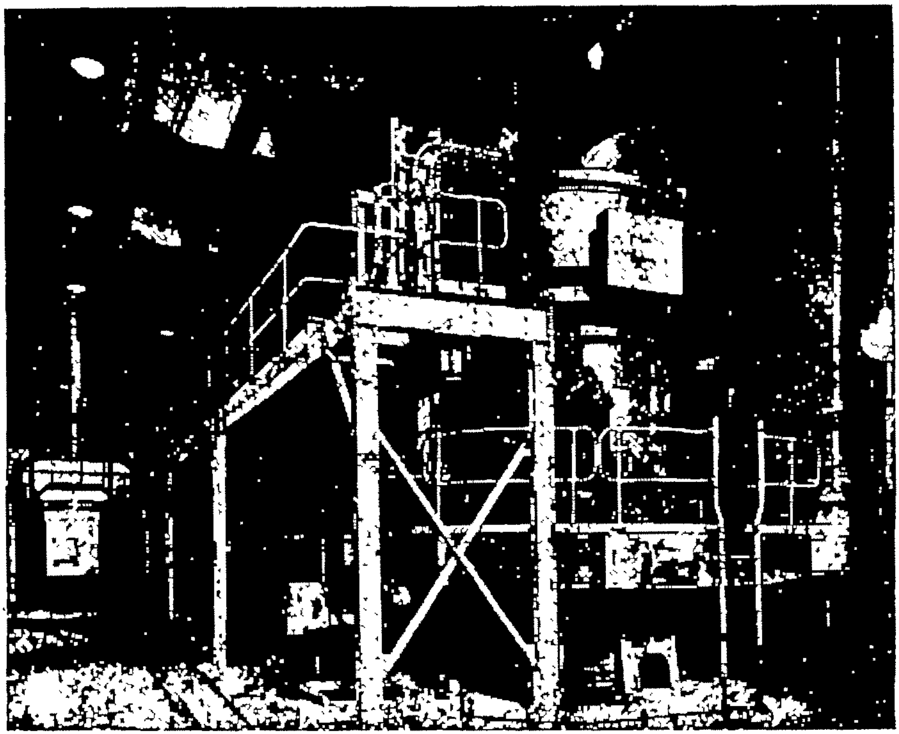


Fig. 4

Pulverizing fuel mills

Retractable lance and gun type blowers are fitted throughout the boiler passes to keep heating surfaces clean and free from deposits. The soot blowers are electrically operated with automatic sequence control.

Preheated air is delivered from duplicate Howden-Ljungstrom regenerative air heaters. Two forced draft fans per boiler deliver air to the preheaters, from which a portion is taken to the mills for drying the coal feed and conveying it to the burners. The remainder is delivered around the burner nozzles as secondary air. The induced and the forced draft fans, coal feeders, mill classifiers and exhauster are driven by A.C. commutator motors, speed variation of these motors being obtained by induction regulators.

Ash and dust handling plant

The ash and dust handling plant is designed to operate on the high velocity sluice system discharging through basalt lined sluiceways to a combined main ash and dust sump. The ash sump is separated from the dust sump by a dividing wall designed to act as a weir and scum board to allow small particles of ash to be carried over into the dust sump with the sluice water, from where it is pumped into a disposal pit. The collection of dust from the plant is made at various points in the system and this dust is discharged into the main sluiceway by means of hydrovactors and feeder ejectors.

The pump house, located near the ash and dust sump, houses the high pressure water pumps for sluicing the ash and dust to the sumps and the dust pumps for pumping dust slurry to the disposal area, approximately 3½ miles from the station.

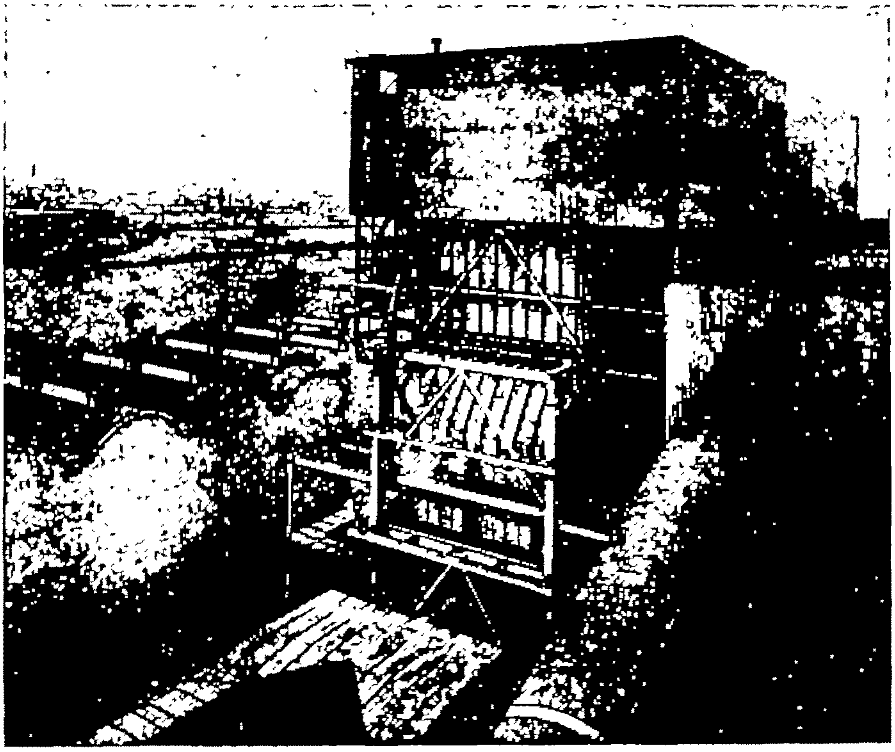


Fig. 5

South-east corner of the boiler house showing boiler bay

Turbo-generators and associated plant

The four 100 MW, 3,000 r.p.m. turbines are of the tandem, three-cylinder, impulse reaction type, and are designed for operating with steam at 1,500 lb. per sq. in. and 1,050°F. The high and the intermediate pressure turbines are of the single flow type with 10 and 15 impulse stages, respectively. The low pressure turbine is of the double flow type with impulse blades for the first stage and reaction blades for the remaining five stages.

The alternators are hydrogen cooled and are rated at 100 MW, 13.8 kV, and 3,000 r.p.m. Each alternator is provided with 1,000 r.p.m., gear driven, air cooled exciters. Ventilation is by means of axial flow fans mounted on each end of the alternator rotor. Two hydrogen coolers are provided which use distilled water flowing in a closed circuit and tubular surface type heat exchangers.

The main exciter has two field windings, one applying a small constant negative excitation and the other for regulation. Thus, it is not necessary to reduce the shunt field current to almost zero to obtain very low excitation voltage. The shunt field regulator is, therefore, smaller than for a single winding, and the automatic voltage regulator duty is reduced. The voltage regulator is provided with automatic control through magnetic amplifiers and a manual control rheostat.

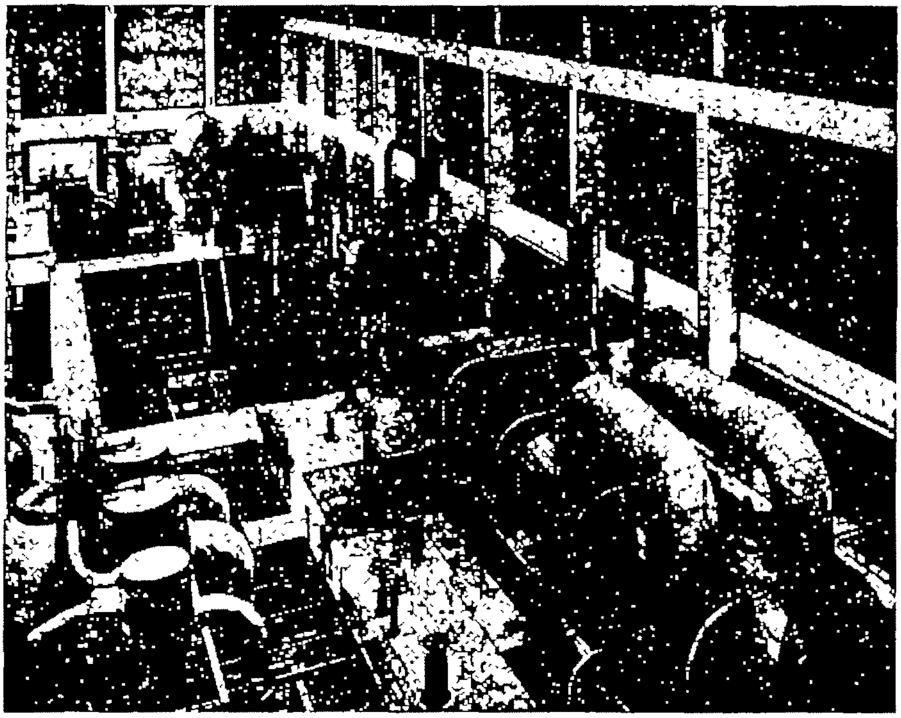


Fig. 5

General view of the turbine house

Steam from double-flow exhaust of the low pressure turbine cylinder passes into twin two pass condensers. The condensate is extracted by 100% duty extraction pumps and air is removed by 50% duty air pumps of the rotary Le-Blanc type. The quick starting air exhauster is of the rolling drum rotary type. The extraction pumps discharge through low pressure heaters into the deaerator surge tank from which water is supplied to the feed system. The pressure of the feed water is boosted up from 50 to 504 lb. per sq. in. by the high pressure heater which also raises its temperature to 410°F. With each turbine is included a double effect bled steam evaporating plant producing 25,000 lb. of vapour per hr. when the machine is delivering the maximum output of 100 MW. Prior to evaporation, the makeup water is softened and its alkalinity removed in a sodium base exchange softening plant which is fed with raw water. The softening plant has a capacity of 10,000 gallons per day.

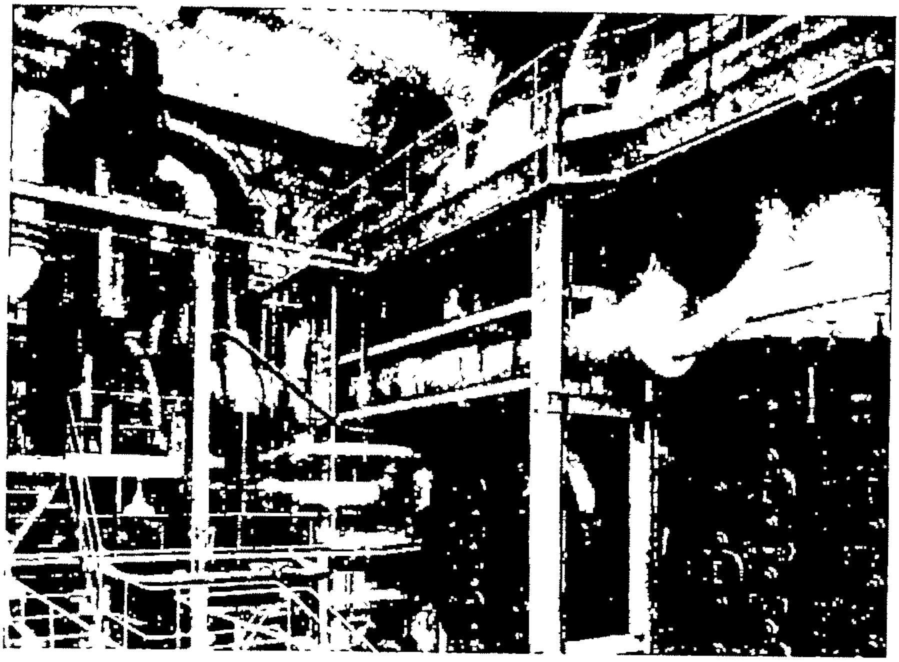


Fig. 6
Condensers and the associated equipment

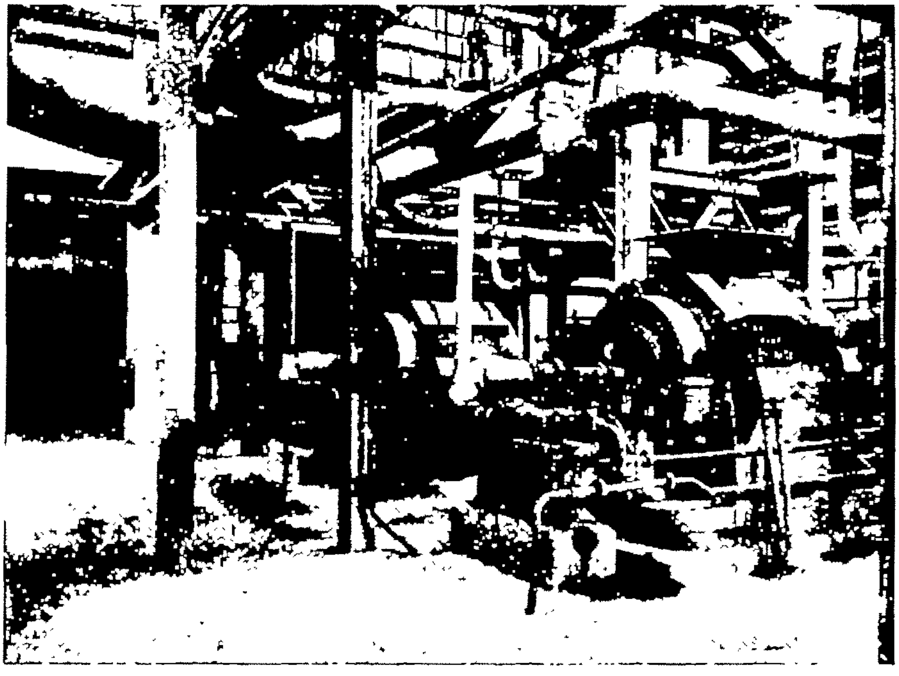


Fig. 7
Feed water pumps

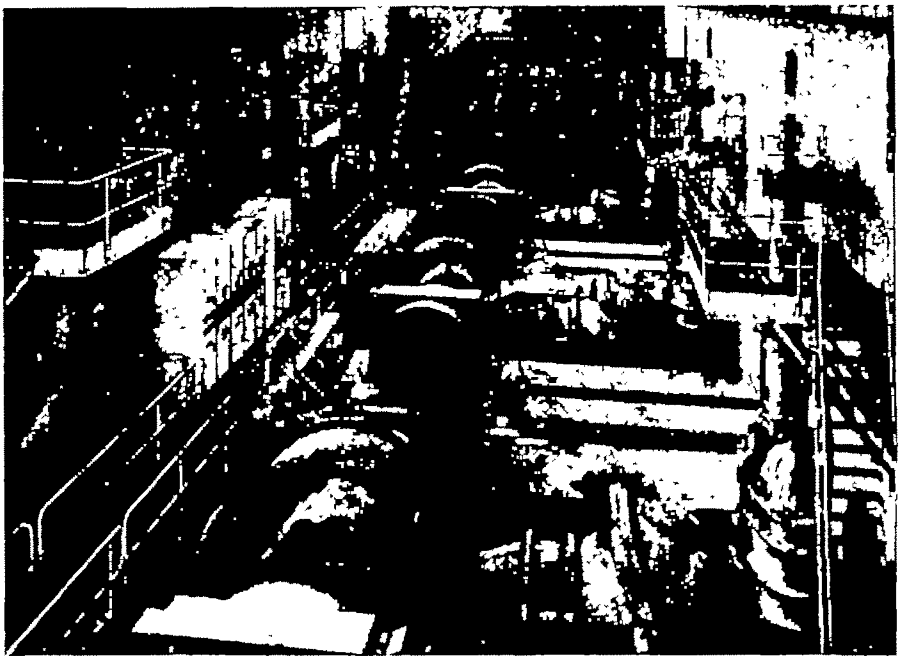


Fig. 8

Circulating water pumps

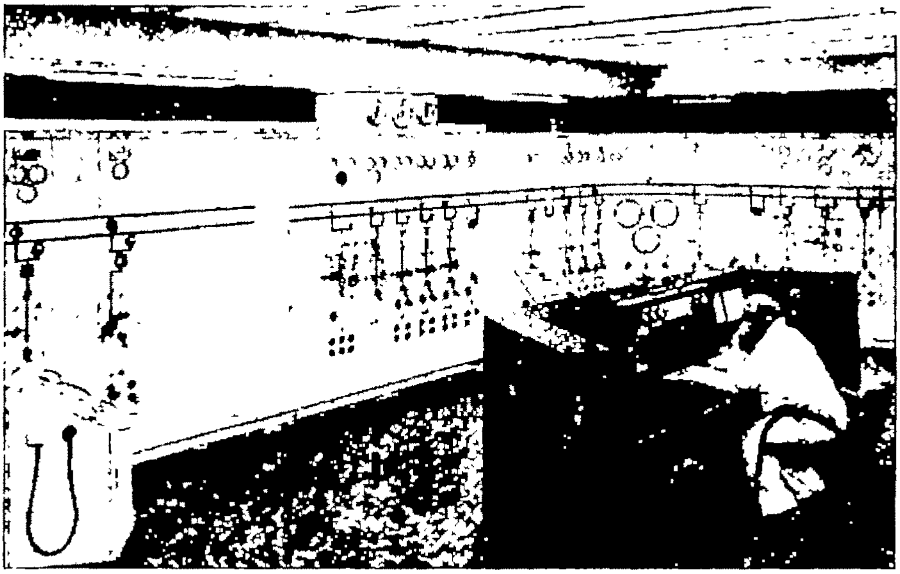


Fig. 9

Main station control room

Each turbo-generator is fitted with supervisory equipment to provide indication and recording of shaft position, eccentricity, vibration, differential expansion and speed.

Circulating water system

The cooling water is taken from the River Trent. Wide variations in the river flow conditions and the limitations of permissible temperature rise in the river water necessitated the use of mixed flow circulating water system utilizing two 4,500,000 gallons per hr. capacity reinforced concrete cooling towers of 300 ft. height. The system is designed to utilize the flow of the river when it exceeds the station demand of 16,400,000 gallons per hr. When the river flow falls below the demand, the deficit is made up by recirculating water from the cooling towers.

High pressure pipe work

The main high pressure steam pipes are designed for a flow of 830,000 lb. per hr. of steam at 1,600 lb. per sq. in. pressure and 1,060°F. temperature at the boiler stop valve. The twin mains from the superheater header to the turbine chest are of austenitic steel, special transition pieces being fitted at junctions with steam chests and turbine casing to allow differential expansion between the two metals. Heaters are provided in the transition pieces to maintain a temperature of 800°F.

Plant and station control rooms

The instruments for automatic control of boiler, pulverizing plant and turbine, together with remote controls for auxiliary motors, alarms, etc. are located in separate

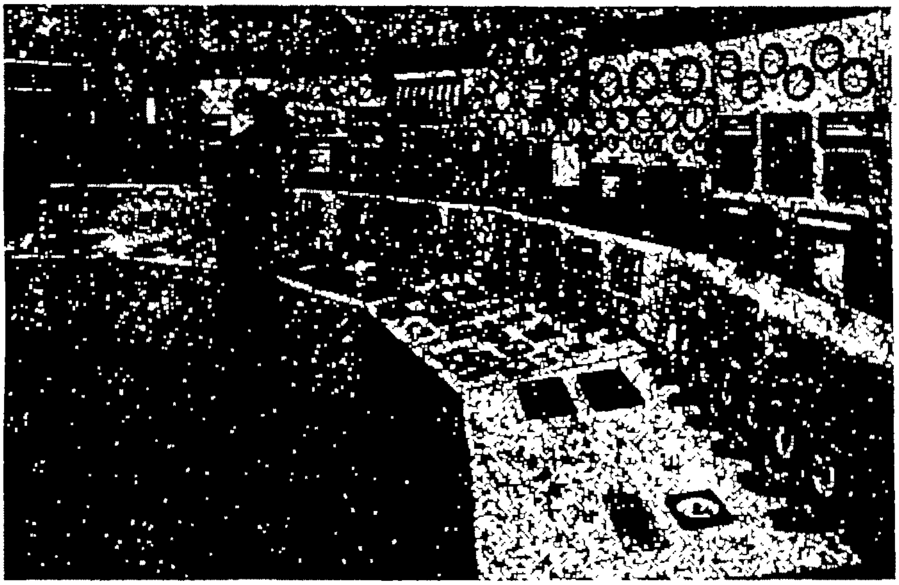


Fig. 10

Plant control room

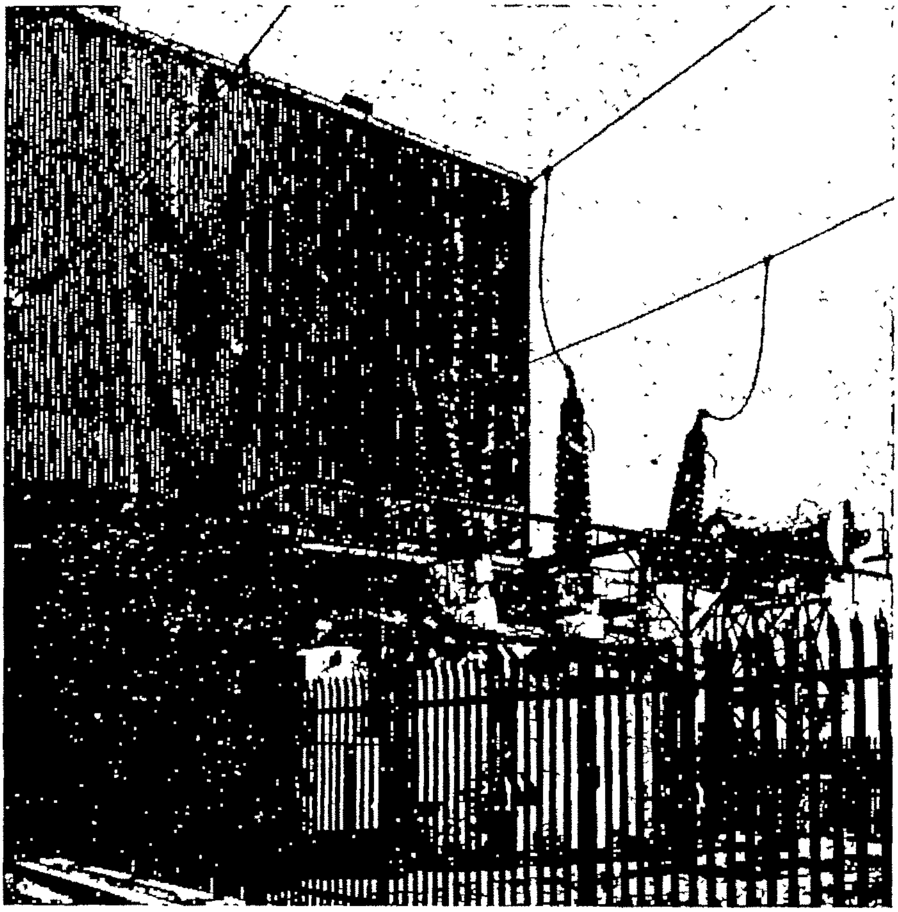


Fig. 11

Generator transformer

plant control room (Fig. 10) for each turbine/boiler unit. Telemetering has been implemented to avoid the entry of high pressure and temperature steam and water connections inside the control rooms. Remote operation of auxiliaries, such as feed pumps, circulating water pumps, tower pumps, etc., is provided from this room.

The station controls and the transmission system controls are located in a separate station control room (Fig. 12).

Transformers and switchgear

Two of the generators are connected through 120 MVA, 13.8/145 kV transformers to the 132 kV switchgear. The machines are switched and synchronized at 132 kV. The remaining two generators are switched and synchronized at 275 kV, and are connected to 275 kV switchgear through 106 MVA, 13.8/295 kV transformers.

The busbars serving the 132 kV and the 275 kV switchgears are interconnected by two 120 MVA auto-transformers. The 132 kV outdoor switching station has 16 circuit-breakers controlling two generators, two 275/132 kV, 120 MVA auto-transformers, seven feeders and two bus-couplers. The 275 kV outdoor switching station has eight bulk oil circuit-breakers controlling two generators, three supergrid feeders, one bus coupler and two 275/132 kV, 120 MVA auto-transformers. The bulk oil circuit-breakers have a rupturing capacity of 7,500 MVA. These are pneumatically operated but can also be closed slowly for maintenance purposes by means of built-in hydraulic jacks. The 275 kV isolators are electrically operated and are provided with electrical and mechanical interlocks. Busbar selection and section isolators are remotely controlled from the station control room.

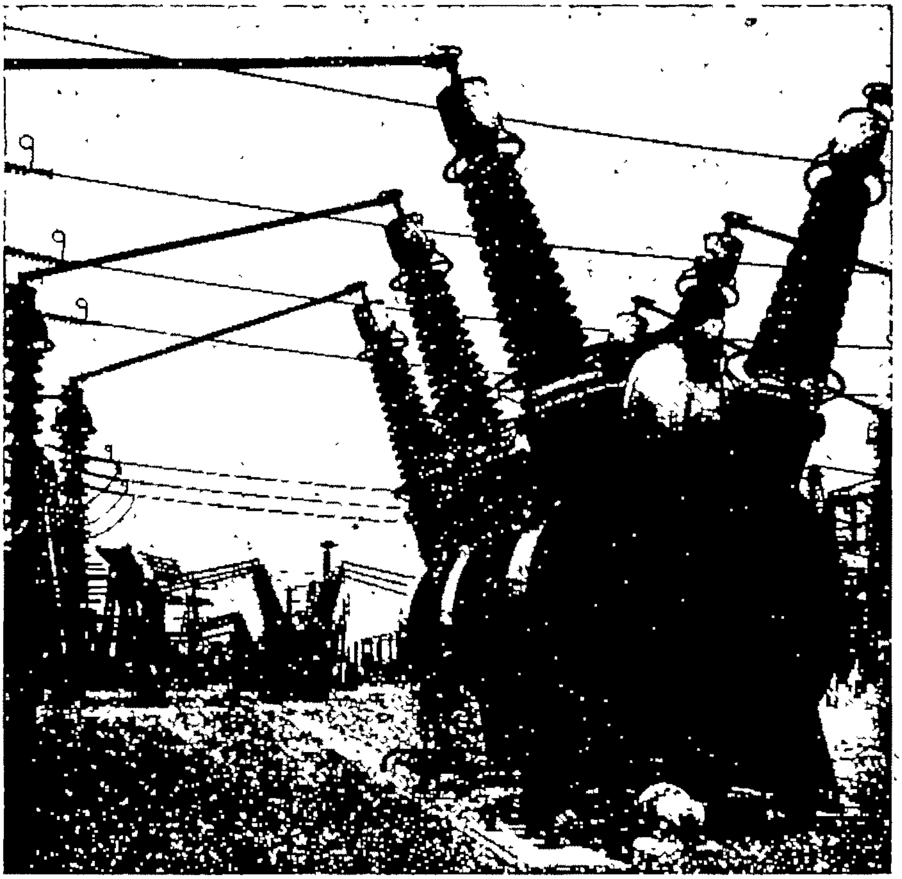


Fig. 13

275 kV oil circuit-breakers

The connections between the two generator transformers switched at 132 kV and from low voltage side of the 275/132 kV auto-transformer to the 132 kV substation are made by single core oil filled cable. The connections from the two generator transformers switched at 275 kV are made by overhead conductors.

Auxiliary supplies and motors

The auxiliary supplies are grouped into unit and station boards for distribution purposes and are supplied from the various unit and station auxiliary transformers.

The 11 kV auxiliary switchgear is of the indoor, oil immersed, single busbar, horizontal drawout type with a rupturing capacity of 350 MVA. The 3,300 volts auxiliary switchgear is of the indoor, airbreak, single busbar, drawout type with a rupturing capacity of 150 MVA.

A large number of auxiliary motors have been provided, ranging in capacity from 2,500 h.p. for the high pressure boiler feed pumps to fractional h.p. motors used for controls. Motors above 130 h.p. are switched on directly at 3,300 volts. The essential standby motors connected with the turbine oil and hydrogen cooling system operate from the main station battery. A large percentage of motors are of the squirrel cage type, started direct on line, but the induced draft fans, forced draft fans, exhausters, pulverizing mill, feeder and separator motors, are of the variable speed A.C. commutator type. All essential auxiliary motors can be remotely controlled from the plant control room.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Mysore Centre

Chairman's address by Shri M. R. Arya, B.E., M.I.E., at the 26th Annual General Meeting of the Centre on December 30, 1960

The Chairman welcomed the Chief Guest, Shri H. M. Channabasappa, Minister for Public Works and Electricity, Mysore State, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1960-61. During his address, Shri Arya spoke on the development of light electrical industry in the Mysore State. He said, 'Since power development can be taken as a direct pointer to the industrial development of the country, I will preface my address by giving a few details about the development, progress and the future plans for power generation in the country.

The Mysore State was pioneer in the production of hydro-electric power in India. In 1902, it started with a generating capacity of 4,500 kW at Sivasamudram. It should be noted that planned development of power in our country started only after independence. The installed capacity of power generating plants in the country was 1,360 MW at the end of 1947 and 2,300 MW at the beginning of the First Plan period. At the end of the First Plan, in 1956, it increased to 3,400 MW. The increase by the end of the Second Plan period is expected to be 2,400 MW, thus bringing up the total to 5,800 MW. This, however, falls short of the original estimate. Consequently, there has been a setback in the industrial development also. It is estimated that the generating capacity required at the end of the Third Plan will be 11,800 MW, *i.e.*, the Third Plan will have to add 6,000 MW.

The State has been a pioneer in setting up practically every type of industry. About 15 years ago, a plan for starting an industry for manufacturing radios and radio components was mooted, and, in February 1946, a company was established.

With the growth of heavy industries, light electrical industries also developed, and they can be taken as a measure of the growth in the standard of living in the country. The light electrical industries set up in the State were for the manufacture of radios and their components, electricity meters, plastic insulated cables, and water meters. These products have a direct bearing on the role of electricity in the furtherance of human comfort and happiness. Extensive rural electrification and rapid growth in the demand for power in urban areas are expected to result in a large demand for meters and insulated wires.

Radio receivers and components

The earlier products of light electrical industry in the State were radio and radio components. The planned beginning of the radio industry took shape in 1949 and the progress during the past decade has been creditable. The radio sets are now entirely of indigenous manufacture and their quality is of a high order. The present annual production level in India is about 268,000 radio sets, which represents a 16-fold increase as compared to 1949.

The structure of the radio industry pervades both into the domain of the large-to-medium size industrial sector and the small scale industrial sector. There are, at present, about 16 registered large-to-medium size units contributing about 82% of the annual production. The remaining 18% is contributed by several small scale unregistered units. The estimated total investment in the industry is about Rs. 5 crores, which employs about 10,000 workers. The target at the end of the Third Plan is for producing 100,000 radio sets.

While the manufacture of radio sets has registered a steep rise, much still remains to be accomplished before reaching self-sufficiency in component manufacture. Nearly 60% of the components for the average domestic radio set are produced indigenously. Self-sufficiency has been achieved in items such as (i) metal parts, (ii) transformers and coils, (iii) wooden and bakelite cabinets and their fittings, (iv) dial scales, (v) knobs, (vi) grill cloth, and (vii) wires. A beginning has also been made in the manufacture of electro-mechanical components like condensers and resistors. Other components such as valves, gang condensers, loudspeakers, valve holders and potentiometers are expected to be produced indigenously by the end of 1961. Some factors which hamper the growth of the industry are : (i) large variety of the components, (ii) numerous types in each variety, (iii) limited demand for a particular type of component, (iv) highly developed and complicated techniques involved in their manufacture, (v) lack of 'knowhow' in the country, (vi) widely dispersed nature of the sources of 'knowhow' in the advanced countries, and (vii) the fast rate of development in the field of electronics resulting in frequent obsolescence of design and manufacturing techniques. As a self-sufficient electronics industry is necessary for both civil and defence requirements, serious attention is now being given to promote the growth of the radio components industry. Attention is also being paid to organize the production of low cost receivers for bringing the benefits of radio listening within the reach of low income groups.

Mysore's share in this progress, though small in the field of radio receiver production, is quite high for component production. A large percentage of radio components is internally manufactured. The production of waveband switch, started only two years ago, is rapidly developing. The manufacture of paper and electrolytic condensers will be taken up soon.

Electricity meters

The increase in generation of electricity and the increasing tempo of electrification during the First and Second Plan periods have brought in their wake an increase in the demand for a variety of light electrical appliances. This has resulted in a large increase in the demand for electricity meters.

The accuracy of measurement of electrical energy consumed is of vital interest not only to the electricity supply undertakings but to the consumer as well. The difficulties encountered in accurate measurement of electrical energy can be appreciated by considering the complexity of the electrical and magnetic interactions which enter into the operation of the measuring device and the sustained accuracy of performance expected with wide variations in load, power factor, voltage, frequency and temperature. It should have an accuracy within ± 2% over the entire load spectrum from 2.5% to 100% of the maximum rated current. It must be capable of recording energy consumed by load of such low value as $\frac{1}{400}$ of the rated maximum current. The extreme temperature and humidity which a meter is likely to encounter in service should not have any deleterious effect, such as corrosion and insulation failure. External magnetic fields should have little or no effect on the performance. At the same time, the instrument must be robust, simple in construction, and should have a long life. These factors are not easy to achieve, as any attempt to improve one tends to adversely effect some other factor.

Prior to 1951, almost the entire requirement of electricity meters was being met through imports. During 1951, steps were taken to start the manufacture of these meters. The production of single-phase meters in India has steadily increased from 1,736 in 1951 to 370,428 in 1959. The production during the first six months in 1960 was 223,165.

Though the increase in the indigenous production of electricity meters is steady, it is not keeping pace with the demand. The estimated demand for meters for use on single-phase circuits, during 1960-61, is 1,000,000, and the estimated annual demand at the end of the Third Plan period is of the order of 1,500,000. This indicates that there is vast scope for increasing the production capacity. In Mysore, a scheme to set up a manufacturing unit for the production of electricity meters was finalized in 1952; production commenced in August 1952, and has increased from 5,052 meters in 1952 to 168,000 in 1959. The production during the first six months of 1960 was 85,542 meters.

Simultaneously with the efforts at increasing the production of electricity meters, a programme has been launched for attaining self-sufficiency in meter components manufacture. At present, only magnets, bearings, etc. are being imported. The meters manufactured in India conform to the British Standard Specifications. However, the work of preparing national Standards was undertaken by the Indian Standards Institution and specifications for electricity meters have been published, with due consideration to the climatic and operational conditions existing in India.

Apart from increasing the production, manufacturers of electricity meters have to diversify the nature of their products by including items like polyphase meters, demand indicators, and ancillary measuring equipment, such as potential and current transformers.

Insulated wires and cables

The insulated wires and cables are indispensable in the utilization of electrical energy. With the growth in the demand for power, the need for such wires and cables is growing. Mysore has set up an industry for the manufacture of plastic cables. The production of rubber and plastic insulated cables in India has gone up from 22.6 million core yards in 1946 to 214 million core yards in 1959. The total capacity licensed up to September 1960 for these cables is 844.9 million core yards. The targets for the demand and capacity at the end of the Third Plan period are estimated at 525 and 900 million core yards, respectively.

P.V.C. insulated cables were first manufactured in India in 1948, and the Mysore State followed it almost immediately. These cables have the following advantages; (i) superior ageing properties, (ii) low moisture absorption, (iii) resistance to oxygen and ozone, (iv) high dielectric strength, (v) high tensile strength, (vi) resistance to flame, (vii) flexibility at low temperatures, (viii) abrasion resistance, (ix) chemical resistance, (x) resistance to oils and greases, and (xi) ease of installation. These cables are used in public utilities, domestic and industrial wiring, radio and other electronic equipment, telephone and telecommunication equipment, and in sea, land and airborne equipment.

The production of P.V.C. cables in Mysore commenced with 560,000 core yards in 1949-50. It is expected that in 1960-61, over 6,000,000 core yards will be manufactured, besides other extruded products like sleeving, tape for insulation, hoses, etc. At present, the manufacturing processes are confined to the extrusion of wires and cables, tinning and stranding of conductors, depending on outside agencies for the supply of annealed bare copper conductors. Plans have been finalized for self-sufficiency in this field by obtaining the machinery required for drawing and annealing of wires. It is also proposed to take up internal compounding of P.V.C.

by impounds by comporting the necessary chemicals, plasticisers, fillers, etc., till indigenous raw materials become available.

Water meters

Protected water supply to a large number of small towns and villages has become possible due to the large scale electrification programmes undertaken by the State. Water meter has become a necessity and its demand is increasing as more towns are launching water supply schemes. At present, the largest producer of these meters is Uttar Pradesh, followed by Mysore. The production figure for 1959 was about 42,000 units. At the end of the Second Plan period, the production is expected to reach about 60,000 units per year.

The water meter produced in Mysore is of the inferential, vane wheel type, based on the multijet principle, the motion of the vane wheel being compensated and balanced. The meter utilizes materials such as high impact polystyrene, natural vulcanite, stainless steel, etc., which are highly resistent to corrosion, thus ensuring durability. A high degree of accuracy in measurement is attained and regulation to the extent of ± 8% is possible.

I would now make a reference to some of the methods adopted in industry to ensure high quality, efficiency and economy in production. One of the essential prerequisites in mass production of light electrical engineering products is the manufacture of accurate tools, jigs, fixtures and gauges. The Radio and Electricals Manufacturing Co., Ltd., Bangalore, is equipped with facilities for manufacturing and maintaining high precision press tools, tools for plastic moulding and injection, dies for P.V.C. extrusion, jigs, fixtures and gauges. To ensure sustained accuracy of the gauges and measuring instruments, a system of periodical comparison and calibration with respect to standard instruments is being followed.

The plant is also equipped with power presses and shears for the manufacture of sheet metal components. Electric spot welders with electronic controls are employed for sub-assembly of sheet metal parts. Turned parts such as terminals, struts and screws are produced on automatic screw cutting machines. Capstan lathes with automatic bar feed attachments, and multiple and single spindle rolling and tapping machines are used. Gears and pinions, which are extensively used in the registering mechanisms of electricity and water meters, are manufactured with the help of gear hobbing machines. The profile of the gears is checked by a high power shadowgraph. A hydraulically operated pressure die-casting machine is employed for the manufacture of main frames, which form the structural elements of the electricity meter. In the finishing shop, operations such as degreasing, pickling, cadmium, zinc, nickel and silver plating, anodizing of aluminium, bonderising and presurfacing of ferrous and non-ferrous parts, and spray painting of lacquer and enamel can be conducted. The coil room, where transformers, coils and electromagnets for use in meters are manufactured, is equipped with multiple coil winding machines capable of winding up to 12 coils at a time with automatic feeding of insulating paper after each layer is wound. Besides, special coil winding machines are used for winding radio frequency coils, intermediate frequency, audio frequency, and power transformers. Facilities are also available for tropic-proofing of transformers, coils and electromagnets by vacuum impregnation. Compressed air is used for operating all pneumatic devices such as spray guns, nut runners, jigs and fixtures and for cleaning dust from meters during assembly and testing operations. Assembly operations are conducted on a belt conveyor equipped with pneumatically operated screw drivers, jigs, fixtures and gauges. During the process of manufacture, inspection is conducted at suitable stages, thus eliminating possible sources of inaccuracy. A system of calibration of sub-standards is employed to ensure accuracy of the measuring instruments manufactured in the factory. Special instruments such as photo-electric servomechanisms, crystal controlled signal generators, shadowgraphs and stroboscopes are extensively employed. Modern techniques of work study, production planning and control, inventory control, and quality control are also used.

A separate inspection department has been set up to prevent defective products passing given points in the production flow, and to report on the quality of the products. Since inspection organization and its functions are closely related to plant line organization and functions, the requirements in the various divisions of the plant have been suitably arranged. As inspection is based on where to inspect, when to inspect and how much to inspect, both floor and patrol inspection combined with a centralized inspection are employed, besides the use of statistical quality control. Managerial control of inspection and quality is maintained to ensure the desired quality of the product as it leaves the plant. Thus, a careful blending of quality control techniques and methods of inspection has been brought about with good results to the industry and creation of quality mindedness in the organization.

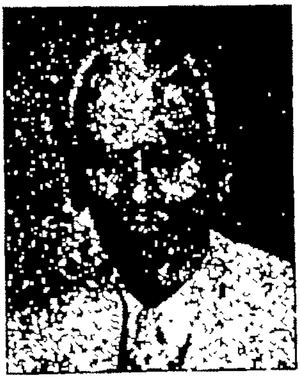
Cost accounting or management accounting has been introduced to achieve low cost production, *i.e.*, increased productivity. This has enabled the management to study the expenses in the factory at frequent intervals. The expenses are divided into cost of materials, cost of labour and overhead costs. These are further subdivided into direct and indirect costs. It has thus been possible to collect data for the cost of production of each unit, cost of each department, service, job or activity, so that they can be controlled as desired. This data forms the basis for comparison of the degree of efficiency achieved. Cost accounting has also made it possible to fix quantity requirements for job and wages on a standard basis and thus to pre-determine the cost. This techniques also enables in advance to fix selling prices correctly and judge the profitability of the products. Another advantage of the system is that a correct appraisal of the proposals for expansion in production can be made.

In the rapid industrialization of our country, engineers will play an important role and it will be necessary for them to become associated not only with the technical side but with the administrative side also. I would strongly urge the engineers to equip themselves with knowledge and experience to become efficient administrators, in addition to being efficient technical men.

In an industry, one has to deal with machines. It is, therefore, necessary that one should understand how to deal with that most complicated machine—the human mind. It needs intelligence, understanding, tact, and, above all, sympathy.'

Rajasthan Centre

Chairman's address by Shri V. G. Garde, B.Sc.(Eng.), M.Sc.(Eng.), M.I.E., at the Second Annual General Meeting of the Centre on January 29, 1961



The Chairman welcomed the Chief Guest, Shri Kanwar Sain, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1960-61. Delivering his address, Shri Garde said, 'India's Third Five Year Plan lays great emphasis on industrialization. Rajasthan's Third Plan envisages the same pattern of development, which means that a large number of technical personnel will be necessary. The proposed outlay in the State's Third Plan on development works with which technical personnel are directly connected will be as follows :

Minor irrigation	..	Rs. 930 lakhs
Irrigation and power	..	Rs. 6,920 lakhs
Village and small industries	..	Rs. 650 lakhs
Mineral development	..	Rs. 550 lakhs
Roads, Transport, etc.	..	Rs. 1,828 lakhs
Technical education	..	Rs. 506 lakhs
Housing	..	Rs. 690 lakhs
Mandis	..	Rs. 150 lakhs

These figures, which do not include the outlay for the Rajasthan Canal scheme and the Song Dam, total Rs. 12,224 lakhs, about 58% of the total outlay for Rajasthan. Besides, technical personnel will also be required for other development works such as in agricultural production, community development, etc.

Since I am connected with the training of technical personnel at almost all levels I will deal in detail with this aspect of the Third Plan. As it takes from one to five years for training technical personnel of different categories, the expansion of technical education during the Second Plan period will provide the personnel required for implementing the Third Plan schemes. Duing the Second Plan period, the position with regard to the training of technical personnel was as follows :

Degree level

Two colleges, with a total annual intake of 385 candidates.

Diploma level

Five polytechnics, with a total annual intake of 760 candidates.

Craftsmen level

Six institutions, with a total annual intake of 1,264 candidates.

It is proposed to expand technical education during the Third Plan period as given below.

Degree level

It is proposed to start a Regional Engineering College at Jaipur with an annual intake of 250 and to increase the intake of the existing colleges at Jodhpur and Pilani to 250 each. At the Regional Engineering College, degree courses in civil, mechanical and electrical engineering, and architecture will be provided. It is also proposed to start post-graduate courses on a limited scale in the existing engineering colleges.

Diploma level

Two polytechnics, at Bharatpur and Jaipur, will be started and the existing polytechnics at Ajmer and Kotah will be expanded. Provision has also been made for starting a diploma course in textile technology in one of the polytechnics. The intake in the polytechnics is expected to increase from 760 to 1,330.

Craftsmen level

It is proposed to expand the existing Industrial Training Institute and to start 11 new institutes with a total intake of 2,200. Thus, the total intake will increase by over 200%.

As technical personnel at the degree and diploma level increase, the activities of the Local Centre will also expand. As indicated earlier, during the Third Plan, an engineering college and a polytechnic will be established at Jaipur, the seat of the Local Centre. It is hoped that field engineers will contribute papers on practical aspects of engineering, and design engineers and senior teaching staff will contribute technical papers on theoretical aspects of engineering.

Technical education in Rajasthan has expanded more slowly than in other States. Expansion beyond a certain rate results in deterioration in quality. This optimum rate of expansion has been exceeded all over India, but to a lesser extent in Rajasthan. The quality of technical personnel being turned out, specially at the degree and diploma levels, is deteriorating rapidly. The following are the main causes for this deterioration :

1. Poor quality of entrants at the degree and diploma levels. This is due to (i) deterioration in the quality of primary and secondary education, mainly because of sudden expansion of education at these levels, (ii) very large intakes in technical institutions resulting in dilution of the quality of students, (iii) sudden increase in the number of teaching staff resulting in deterioration in the quality of staff, and (iv) shortage of senior staff in technical institutions.

2. Change of medium of instruction from English to the regional language. Although, it may not be possible to completely check the deterioration in the standard of technical education, it should be possible to retard the rate of deterioration. The following remedies are suggested :

(i) It would be in the fitness of things if the expansion of technical education during the Third Plan is stopped and the resources, time and energy are devoted to consolidation of the existing facilities. As this does not appear to be possible, we should slow down the rate of expansion.

(ii) The duration of engineering degree courses has been extended to five years with Higher Secondary as the minimum qualification for admission to these courses. The first year of the five year integrated degree course is intended to bring the students up to the Intermediate Science standard. Due to deterioration of secondary education, provision of one year is not enough for this purpose. Besides, considerable time will have to be devoted during the first year to the teaching of English, so that the students may be able to understand lectures and express their ideas in English. It will, therefore, no longer be possible to cover the original four year degree course in five years.

I have discussed this matter with principals of a number of engineering colleges and have come to the conclusion that the syllabus is too lengthy for these classes. The Board of Studies in Engineering and Technology of the University of Rajasthan has, therefore, recommended the appointment of a sub-committee for toning down the degree course. The Board will have to tone down the diploma course also to give it a more practical bias. The difficulties which technical education at the diploma level is facing are greater than those at the degree level.

The country requires the following two types of engineers :

1. Type A, for teaching, research and design work. For this type, an engineer with theoretical knowledge of a high order is required.
2. Type B, the construction and maintenance engineer. For this, a syllabus with a practical bias is needed.

The country needs about 10% of Type A and 90% of Type B engineers. The existing courses are designed to train an engineer to play the role of Type A as well as Type B, with the result that he can play neither of the roles efficiently.

In Rajasthan, after the establishment of the Regional Engineering College, the annual intake to the degree courses will be 750. With the existing syllabus, it will be impossible to find 750 students annually of the right calibre. We should, therefore, consider whether have two types of degree courses, *viz.*, the honours course for Type A and the ordinary course for Type B.

In the programme for industrial training institutes, there is provision for training of craftsmen for civil engineering trades. These trades have not proved to be popular because no regulations have been laid down making it obligatory for employers to employ only trained craftsmen. If the output of Indian craftsmen in the civil engineering trades is compared with advanced countries like Germany, we find that it is about one-third, and the quality of work turned out by them is much inferior. With trained craftsmen, the type as well as the quality will improve considerably. It is time that we took the first step in this direction.'

Summaries of Papers Published in the Journal, vol. 42, no. 2, pts. EL 1 and CH 1, October 1961

ELECTRICAL ENGINEERING DIVISION

Electric Traction

P. N. Murti

Non-member

The reasons for and the method of selecting a section of a railway for electrification is by and large a question of pure economics. An existing railway installation consists of fixed assets such as tracks, buildings, signals, workshops, running sheds, rolling stock, etc., and the maximum utilization of these assets is the primary concern of the railway administration. If an expensive track exists and only a few trains are run on it, then the unit cost of running becomes uneconomical. Therefore, the use to the maximum extent of the assets is a fundamental necessity to achieve maximum economy.

The maximum extent of traffic that can be handled by a track depends on factors such as the motive power used, and the signalling installations and their spacing. The reason why electrification is justifiable in certain cases is that it increases the traffic capacity of a section by virtue of the higher loads and higher speeds at which trains can be hauled. For any given section, if the railway administration finds it difficult to increase the number of trains or the speed and the load of trains, the question of electrification immediately presents itself.

The first electrification schemes in this country were completed on the 1,500 volts D.C. overhead system around Bombay and Madras. After a lapse of two decades, it was decided to adopt 300 volts D.C. when the electrification of the Calcutta suburban section (Howrah-Burdwan) was undertaken in 1954. At this time, the French National Railways had succeeded in demonstrating to the world the feasibility and advantages accruing from a high voltage single-phase A.C. system working directly on industrial frequency. It was in 1956, after studying the report from France, that the Indian Railways decided to investigate its advantages and the possibility of its adoption. The technical and economic aspects of electrification systems, the electrification projects under study and execution, the work coordination methods, and the problems of suburban electrification, training of personnel, and the future prospects of railway electrification, specially in India, are outlined.

Modern Methods of Controlling Load and Frequency in Interconnected Power Systems

A. de Quervain

Non-member

Power system control involves coordination of the production and consumption of electrical energy within a commercial area, so that the frequency is kept within predetermined limits, the facilities for production and transport of power are utilized to the best advantage, and the production cost is kept as low as possible. Interconnected operation of power systems is an advanced form of system control in which these requirements are imposed on two or more systems which are interconnected, in addition to the task of one system assisting the other in the event of a breakdown.

The technical features of load and frequency control in an interconnected power system includes control circuits, telemetering links, networks, controllers and turbine governors. These are discussed in this paper. The conditions which a system controller must fulfil in modern interconnected system operation are outlined. The principles of system control using digital methods and technical data for a typical digital network controller are given.

Special Features of 25 kV A.C. Electric Traction with Particular Reference to Ignitron Electric Locomotive

B. V. S. Rao

Associate Member

Railway electrification is a colossal task requiring close coordination between various branches like overhead equipment, power supply, project planning, rolling stock, signal and telecommunication, civil engineering, etc., both in the field and in the design office. The Indian Railways have embarked on a large programme of electrification, and it is gratifying that Indian engineers have now acquired the knowhow with of 25 kV A.C. traction with the help of French engineers of the S.N.C.F. and are now able to deal with the work independently.

It is not necessary to refer to the well known general advantages of electric traction whether D.C. or A.C. over steam traction such as conservation of metallurgical coal, elimination of smoke nuisance, faster trains, higher sectional capacity of existing tracks, improved operational facilities, cleaner travel, amenities to passengers, etc. Vast sums of money have been spent for research and development all over Europe by leading manufacturers and railway administrations, and it is only recently that there has been a consensus of opinion amongst traction engineers that 25 kV A.C. system is the best for railway electrification. The reasons are not far to seek. One of the unique features of 25 kV A.C. traction is the very substantial reduction in cost which can be effected on the overhead equipment, substations and the locomotives. The paper outlines the special features and technical aspects of 25 kV A.C. electric traction with particular reference to the ignitron electric locomotive.

Bundle Conductors—Equivalent Radius and Maximum Potential Gradient

Dr. V. S. Subba Rao

Non-member

As bundle conductors are being increasingly used on lines of 220 kV and higher voltages it is necessary to be conversant with the methods of evaluating bundle conductor line performance. As 2, 3 and 4 sub-conductors per phase are already in use in different countries, these methods should be applicable to bundles of *n* sub-conductors also. The idea of 'equivalent conductor' is stated and a mathematical derivation for the value of equivalent radius is given. The limitations of these equations are also explained. A method of calculating the maximum potential gradient occurring at any point on the sub-conductor surface of a bundle and the dependence of this gradient on the equivalent radius are outlined.

CHEMICAL ENGINEERING DIVISION

Utilization of Industrial Wastes

S. Prem Singh

Student

'Waste not want not' though an old saying is still true today in spite of revolutionary methods of large scale production. It is more particularly so in the case of a country like ours which is passing through an era of industrilization. To a careful observer, so many sources and ways of waste are apparent in the domestic, agricultural and industrial spheres that it is only when we begin to collect this waste we realise their volume and utility potential. Even the most insignificant waste, if properly collected and utilized, can be turned into a source for newer products, novel uses, and increased employment.

Effect of Mica Content of Sand on Quality of Concrete

Contributed by The Bihar River Research Station, Khagaul

The problem whether micaceous Kosi sand could be safely used in concrete work led to intensive studies on the effect of mica content of sand on cement mortar and concrete. It was observed from laboratory experiments on mix design that the actual compressive strength of concrete prepared with micaceous Kosi sand did not fall short of the required strength. The views by foreign experts agree that the harmful effect of mica depends on its type, particle size, and the degree of deterioration on concrete which has to be ascertained by standard laboratory tests.

INSTITUTION NOTICES

The Institution *vis-a-vis* the Indian Companies Act, 1956

The name of the Institution incorporated under the Indian Companies Act, 1913, has been removed from the Register of Companies, and the fact has been notified in a Gazette of India Notification dated May 6, 1961, a copy of which is reproduced below for information.

'604 THE GAZETTE OF INDIA MAY 6, 1961
PART III—SEC. I

CALCUTTA, the 24th April 1961.

In the matter of the Companies Act, 1956 and of
M/s. Institution of Engineers (India).

No. 4200/560(5) Notice is hereby given pursuant to Sub-section (5) of Section 560 of the Companies Act, 1956, that the name of M/s. Institution of Engineers

(India) has this day been struck off the Register and the said Company is dissolved.

Sd./- A. C. Sarkar
Asst. Registrar of Com. W.B.'

The Institution of Engineers (India) incorporated under the Royal Charter, 1935, therefore, does not have to comply with any of the provisions of the Indian Companies Act, 1956.

Table of composition fees for membership for life of the Institution

Enquiries have shown that many Corporate Members are not aware of the rules governing the compounding of subscriptions for becoming Members or Associate Members for life of the Institution. The Table of Composition Fees is given as an Appendix to the 'Regulations of the Council', a copy of which is given to each member on election. The table is reproduced below for information.

Age next birthday	Member	Associate Member	Age next birthday	Member	Associate Member
26		665	41	676	521
27		660	42	657	505
28		654	43	634	489
29		646	44	612	471
30		639	45	589	453
31		630	46	563	433
32		623	47	534	410
33		614	48	504	388
34		604	49	473	364
35		595	50	439	338
36	759	585	51	404	310
37	745	573	52	365	281
38	729	560	53	324	249
39	712	548	54	280	215
40	696	535	55 and over	231	179

Note : Members and Associate Members who have attained the age of 55 years or over and have retired from active duty may compound their future annual subscriptions at the following rates :

For Members	.. Rs. 200
For Associate Members	.. Rs. 150

Tentative design Standards for sewage works

The tentative design Standards for sewage works, as redrafted by the Public Health Engineering Group of the Institution, are given below. Members are requested to send their suggestions and comments on these tentative Standards to the Secretary, Public Health Engineering Group, the Institution of Engineers (India), 'The International', 16 Queen's Road Estate, Bombay 1.

Screening devices

1. All sewage treatment plants should provide protection to pumps and other equipment in the plant by installing screening devices. Manual or mechanically cleaned bar screens may be used. It is recommended that all the sewage treatment plants receiving a flow of 400 $m.^3$ per hr. (about 2 m.g.d.) or more should install mechanically cleaned bar screens.

   Bar racks should preferably be placed at the start of the treatment plant.

2. *Location*

   Screens can be located either in deep pits, inside buildings or in the open.

   (a) Screening devices should preferably precede grit chambers. Where grit quality is not of much consequence, as in land filling, the screening devices may be placed after the grit chambers.

   (b) In deep pits : Screening devices located in deep pits should be provided with stairway access, adequate lighting and ventilation, and convenient and adequate means for removing screenings.

   (c) In buildings : Screening devices installed in a building where other equipment or offices are located should be separated from the rest of the building by partitions, and provided with adequate means of ventilation.

   (d) In open fields : Screening devices installed in open fields should be preferably of the open channel type. Provision may be made for roofing over the screens.

3. *Spacing of bars*

   (a) Bar racks : Clear openings between bars should be 75 to 100 mm. (2½ to 3 in.).

   (b) Mechanical screens : Clear openings between bars should be 20 to 25 mm. (¾ to 1 in.).

   (c) Manually cleaned screens : Clear openings between bars should be 25 to 40 mm. (1 to 1½ in.)

4. *Cleaning devices*

   (a) Mechanical screens should be automatically cleaned periodically and should be provided with time clock or float control devices which will set the cleaning mechanism in operation.

   (b) Manually cleaned screens should be so constructed that they can be conveniently raked. A hand rake should be provided. Hand cleaned screens should have a slope of 30° to 45° with the horizontal.

5. *Effective area and velocity*

   Channel

   (a) Screens should preferably be designed to provide a velocity through the channel of 0.3 mile per sec. (1 ft. per sec.) at average flow.

(b) Screens should preferably be designed such that the velocity through the screens at maximum flow does not exceed 0.75 mile per sec. (2.5 ft. per sec.).

Bar racks

The effective area should be taken by considering the vertical projection of the screen openings from the invert to the flow line at the flow under consideration. The total net area of the openings between the bars should preferably be such that a maximum velocity of about 0.75 mile per sec. (2.5 ft. per sec.) is maintained.

6. *Disposal of screenings*

(a) Handling: Where hand cleaned screens are installed, ample facilities should be provided for the removal, handling and disposal of screenings.

(b) Platform: Hand cleaned screening facilities should include an amply sized, accessible platform from which the operator may rake screenings easily and safely.

(c) Drainage: Suitable drainage facilities should be provided both for the platform and for such devices as may be necessary to store the screenings.

(d) Storage: Suitable storage facilities should be provided where temporary storage of screenings is necessary.

(e) Disposal: Definite provisions should be made for satisfactory disposal of screenings.

7. *Bar screen channels*

(a) The screen channel invert downstream of screens should drop 75 to 150 mm. (3 to 6 in.) below the invert of the screen channel.

(b) The channel preceding and following the screens should be filleted to prevent stranding and sedimentation of solids.

(c) Sufficient freeboard should be provided.

(d) Design of approach channel should provide for gates, etc. to shut off the flow, divert the flow to other units or bypass it.

8. *Number of screens*

Where mechanically operated screening devices are employed, auxiliary units should preferably be provided. These auxiliary units can be either mechanical or manual screens. Arrangement should be made for suitable diversion of flow.

Grit removing devices

1. All sewage treatment plants should provide for grit removal. Grit removal devices can be either of the hand cleaned type or mechanically operated. It is recommended that all sewage plants where the average flow is 200 m.^{3} per hr. (about 1 Imp. m.g.d. or more) should preferably provide mechanical units.

2. *Location*

Grit chambers should be located, in general, after the pumps.

3. *Number and type of units*

For comparatively small sewage treatment plants, single or duplicate hand cleaned grit chamber channels are sufficient. Where the sewage treatment plant is receiving sewage through combined sewers or where the amount of grit present in the sewage is known to be significant, a single mechanically cleaned grit chamber with a bypass to the plant effluent should preferably be provided. The bypass should preferably be designed with a hand cleaned grit chamber for removal of 65 mesh and adequate grit storage. In large plants, where necessary, the use of two or more mechanically cleaned grit chambers may be considered by dividing the flow.

4. *Design factors*

(a) Flow : Grit chambers should be designed for the daily maximum flow if the maximum flow is known. If not known, the daily maximum flow should preferably be assumed as equal to three times the average or design flow and the grit chamber designed for this maximum flow.

(b) Area : Sufficient area should be provided to assure the desired removals. For removal of 100 mesh (about 0.15 mm. particle size) grit, the area provided should be not less than 2.25 $m.^2$ per 100 $m.^3$ per hr. flow in case of designs governed by surface area only (about 46 sq. ft. per m.g.d. flow).

5. *Grit washing*

If grit quality is of no consequence, as in cases of land filling, grit washing may be omitted, otherwise mechanially operated grit chambers should be provided with grit washing devices for the separation of organic materials from the inorganic grit. Arrangement should be made to return the organic matter to the treatment plant. Grit washing should be done immediately after grit collection and the wash returned.

6. *Grit removal*

Provision should be made for grit discharge and removal so as to facilitate its disposal. Grit chambers located in pits should have facilities for lifting grit to ground level.

7. *Grit disposal*

Adequate arrangements should be made for the disposal of clean grit.

8. Manually cleaned grit chambers should preferably be designed so that turbulence is minimum. All grit chambers should have drains.

9. Adequate freeboard should be provided in grit chambers as well as approach channels.

Clarifiers or sedimentation basins

1. All sewage treatment plants, except those which are designed for small volumes of flow, should preferably provide clarifiers with mechanical sludge collecting and removing arrangements.

2. *Location*

The primary clarifier should be located after the grit chamber. The final clarifier, where provided, should generally be located such that the treated effluent is discharged directly after passing through the final clarifier.

3. *Number of units*

The number of units should be decided by the volume of sewage treated and the type and degree of treatment desired. For large plants and in all cases where the removal of a single unit from service for short periods will result in objectionable conditions, multiple units may be considered to provide greater flexibility.

A. Primary clarifiers

1. *General features*

(a) Inlet design : All inlets should be designed to diffuse the flow equally across the entire section of the clarifier and prevent short-circuiting.

(b) Outlet design: Overflow devices of adequate capacity should be provided. On tanks provided with weirs, care should be taken to ensure that the tops of the weirs are in one level.

(c) Scum baffles : Scum baffles should be provided ahead of the overflow devices.

(d) Skimming device : A skimming or scum removal device should be provided to collect all scum and other floating matter and drain it into a suitable receptacle for further treatment in a digester and/or disposal.

(e) Facilities : All clarifiers should be provided with handrails, walkways, ladders, etc. for easy access and maintenance, and should comply with all Government and local rules and regulations.

(f) Sludge collection and removal : The sludge settled on the floor of the clarifier should be continuously raked by the rake arms of the sludge scraping mechanism. The sludge collected should be discharged by hydrostatic head or by pumping.

2. *Design factors*

(a) Area : Sufficient area should be provided to ensure a B.O.D. removal of 30 to 40%. The area considered should include the settling area of the clarifier, and the volume of flow considered should be the design for average flow plus such other flows as recirculation, which also enter the primary clarifier.

(b) Overflow rate : Primary clarifiers should be designed to have an overflow rate not exceeding 1.4 m. per hr. (700 gallons per sq. ft. per day = 4.65 ft. per hr.).

(c) Detention period : The primary clarifier should preferably provide a detention period of 2 to 2½ hours for the average flow entering the clarifier.

3. *Depth*

The side water depth of the mechanically cleaned clarifiers should preferably be not less than 2.0 m. (6 ft. 6 in.). Adequate freeboard should be provided.

4. *Floor slopes*

The floor of the mechanically cleaned clarifier should be slightly sloped towards the sludge collection pit or hopper, where provided. A slope of 1 in 12 is suitable.

B. Final clarifiers

1. *General features*

(a) Inlet: As in primary clarifiers.

(b) Outlet: As in primary clarifiers.

(c) Scum baffles: There is no need to provide scum baffles in final clarifier.

(d) Skimming device: There is normally no need to provide skimming device in final clarifiers.

(e) Facilities: As in primary clarifiers.

(f) Recirculation device: Where high rate trickling filtration is employed, it is necessary to return a part of the oxidized effluent (recirculation flow) to be mixed with the sewage. Devices, such as recirculation launder, of sufficient capacity should be provided for withdrawing the required volume of recirculation flow.

(g) Return sludge: Whether high rate trickling filtration or activated sludge process is employed, the sludge from the final clarifier is required to be continuously collected and removed. Provision for continuous sludge removal should be made and this should be returned either to primary clarifier or to aeration tanks or both, as required.

2. *Design factors*

(a) Area: Sufficient area should be provided to ensure the required quality of the effluent.

(b) Overflow rate: Final clarifiers in high rate trickling filtration should have an overflow rate not exceeding 1.2 m. per hr. (600 gallons per sq. ft. per day = 4 ft. per hr.), and for all flows excluding underflows and such other withdrawals which do not affect the overflow. Final clarifiers in activated sludge plants should generally have an overflow rate lower than used for high rate trickling filtration plants under same circumstances to account for the lightness of floc in activated sludge plant.

(c) Detention period: Detention period in final clarifiers used in high rate trickling filtration plants should preferably be two hours. The detention periods in final clarifiers used with activated sludge plants should preferably be related to the period and effectiveness of aeration provided.

3. *Depth*

The side water depth of mechanically cleaned final clarifiers in high rate trickling filtration plant should not be less than 2.0 m. (6 ft. 6 in.). Final clarifiers in activated sludge plants should have a minimum side water depth of 2.4 m. (8 ft.). Adequate freeboard should be provided.

4. *Floor slopes*

As in primary clarifiers.

C. Non-mechanical clarifiers

Where the flow is not large enough to justify the use of mechanical clarifiers, non-mechanical clarifiers may be considered.

General features

(a) Inlet : As in primary clarifiers.

(b) Outlet : As in primary clarifiers.

(c) Scum baffles : Scum baffles should be provided before the outlet device, and arrangement should be made to skim off the scum floating on top.

(d) Sludge hoppers : Pyramidal or conical hoppers can be used. Adequate slope should be given to the sides.

(e) Facilities : As in primary clarifiers.

(f) Baffles : Baffles should be provided where necessary to dissipate the velocity.

Secondary treatment

A. Trickling filters

1. Trickling filters should be classified as 'standard rate' and 'high rate' units, on the basis of volume of flow per unit area of surface and the biochemical oxygen demand load per unit media volume. Trickling filters should be designed to provide the necessary reduction in B.O.D. These should be designed for continuous and uninterrupted operation. Generally, the following criteria should be used :

Standard rate filters

Dosing rate : 1,500 m^3. per hr. per ha. (max.) (about 3.3 Imp. m.g.d.)

Loading rate : 25 kg per 100 m^3. (max.) per day (about 0.4 lb. per c. yd. per day)

High rate filters

Dosing rate : 5,000 to 12,500 m^3. per hr. per ha. (10 to 25 Imp. m.g.d.)

Loading rate : 0.9 to 1.0 kg per m^3. per day (1.75 to 2 lb. per c. yd. per day)

The B.O.D. considered should be the settled raw sewage B.O.D.

1 ha. (hectare) = 10,000 m^2

2. *Location*

Design of trickling filters to treat municipal sewage should be provided with pretreatment by primary clarifiers. It is to be done to reduce organic loading as well as to remove solids from sewage which might otherwise clog the distributor and the filter media.

3. *Number of units*

The number of units should be decided by the volume of sewage treated, the type of flowsheet used, and the degree of treatment desired. Where necessary, the use of multiple units may be considered by dividing the flow suitably.

4. *General features*

(a) Distribution : The sewage should preferably be distributed over the filter by moving the distributors.

(b) Dosing : The distributor may be actuated by siphons or pumps or by gravity discharge.

(c) Hydraulics : All hydraulic factors involving proper distribution of sewage on the filters should be carefully considered.

(d) Uniformity of distribution : The sewage should be distributed as uniformly as possible.

5. *Filter media*

(a) Quality : The filter media may be crushed rock, slag, clinker, or specially manufactured material. The media should be resistant to spalling or flaking and be otherwise unaffected by sewage.

(b) Size : The size of media depends upon whether a filter is primary, secondary or a roughing filter. Primary and roughing filters should preferably have media size from 7.5 to 12.5 cm. (3 to 5 in.) and secondary filters from 5 to 10 cm. (2 to 4 in.). It is very essential that the size of media be as uniform as possible. It should be free from dust, clay, sand or fine material. The media should be approximately cubical in shape and free from flat or elongated pieces. Wherever possible, the use of filter units of the same size should be considered.

(c) Placing of media : The media should be screened or forked at the sewage treatment plant site to remove all fines. The media should be placed carefully in the filter. Breakage and segregation of different sizes should be avoided.

(d) Depth : The depth is usually arrived at by providing the necessary dosing rate. High rate trickling filters are generally found to have depths in the range of 1.0 to 1.75 m. (3 to 6 ft.).

6. *Underdrainage*

(a) Arrangement : Underdrains with proper inverts should be provided and the underdrainage system should cover the entire floor of the filter. Inlet openings into the underdrains should have adequate area.

(b) Slope : The underdrains should have adequate slope. A minimum slope of 1% should be used. Effluent channels should be designed to produce a minimum velocity of 0.6 m. per sec. (2 ft. per sec.) at average daily rate of application of the filter.

(c) Flushing : Provision should be made for flushing the main underdrain channel. Inspection facilities should be provided.

(d) Ventilation : The underdrain system, effluent channels, and the effluent pipe should be designed to flow partially full to permit free passage of air. Adequate capacity for these will ensure good ventilation. Devices to ensure ventilation, such as vent pipes at the periphery, extension of underdrain through the wall, etc., should be installed. Forced ventilation should be preferred with deep filters.

B. Activated sludge process

1. The activated sludge plant should be designed to provide the necessary reduction in B.O.D. The operation should be continuous and uninterrupted.

2. *Location*

As in trickling filters.

3. *Number of units*

As in trickling filters.

4. *Design Features*

(a) Aeration tank volume : Aeration tank volume should be based upon the strength of incoming sewage and the degree of treatment required.

(b) Aeration tank dimensions : The aeration tank should be so dimensioned and proportioned that each independent unit is able to (i) maintain effective mixture and utilization of air, (ii) prevent unaerated sections, noticeable channelling, and (iii) maintain sufficient velocity to prevent settling of solids.

(c) Return sludge : Provision should be made for returning adequate amount of activated sludge.

(d) Aeration : The design should provide for the introduction of air in sufficient volume and in such a manner as to (i) maintain the required dissolved oxygen under all conditions of loading, (ii) maintain sufficient velocity and turbulence so as to bring all portions of sewage into intimate contact, and (iii) prevent deposition of solids.

The above factors should be satisfied by designs which provide compressed air or mechanical apparatus other than or supplementary to the compressed air as a means of flocculating, oxidizing and aerating the contents of the tanks.

5. *General features*

(a) Inlets and outlets should be equipped with suitable controls, such as gates, weirs, etc.

(b) Channels, pipes, etc. should be designed to carry liquids with solids and maintain a self cleansing velocity.

(c) Drainage arrangement should be provided, where necessary, in aeration and other tanks.

(d) Bypass arrangement should be provided.

(e) Sufficient freeboard should be provided.

Sludge digestion and disposal

1. All sewage treatment plants where raw sludge obtained from sedimentation of sewage cannot be disposed without causing nuisance or danger to public health should provide for separate digestion of sludge. Digestion should reduce complex organic matter to a simpler, non-objectionable state and the digested sludge should be amenable to easy and safe disposal.

2. *Number of units*

The number and type of units should be dependent upon the volume of sludge to be digested and the type of digestion required.

3. *Design features*

(a) Volume of digester : Adequate digestion volume should be provided. The volume should preferably be based upon the volume of sludge to be handled, the period of digestion, taking into account the temperature, the degree of digestion required, etc. Where designs are empirically based upon the population served, a digestion volume of not less than 0.03 $m.^3$ per capita (1 c.ft. per capita) for primary treatment and not less than 0.06 $m.^3$ per capita (2 c.ft. per capita) for complete treatment may be used. The need for additional digestion volume as a result of thinner sludge obtained in the activated sludge process should be taken into account.

(b) Adequate provision should be made for mixing of sludge in the digester.

4. *General*

(a) Maintenance facilities : Facilities for emptying, cleaning and inspection should be provided.

(b) Adequate number of manholes should be provided.

(c) Sludge pipes should be sized and designed to ensure trouble free operation by having them as short and as straight as possible.

(d) Adequate provision should be made for safe gas collection and disposal. When specified, adequate arrangements for utilization of gas should be made. All such arrangements should have safety facilities such as pressure and vacuum relief valves, flame traps, water seals, etc.

(e) Sludge heating devices are not considered essential for climatic conditions usually encountered in India. Where local climatic conditions warrant the need for sludge heating, the same should be provided.

(f) Adequate provision should be made for periodic removal and safe disposal of the supernatant liquor.

5. *Sludge driving beds*

(a) Area: Sludge bed area should be based upon weather conditions. Usually, in sewage treatment plants receiving 400 m.^{3} per hr. (about 2 m.g.d.) or more sewage, a sludge bed area of about 0.045 m.^{2} per capita (0.5 sq. ft. per capita) is satisfactory. Sewage treatment plants of smaller capacity should perferably be provided with sludge bed area varying from about 0.054 to 0.063 m.^{2} per capita (0.6 to 0.7 sq. ft. per capita).

(b) Design: The sludge drying bed should consist of an underdrain, layers of graded gravel and stone, and a top layer of sand.

Underdrains should be of proper design and should be laid with open joints. The spacing should be adequate.

Properly graded gravel should be used on the top of the underdrain. Gravel should preferably be placed in two or more layers. Adequate thickness for each layer should be provided.

The top layer of sand having effective size not less than 0.5 mm. should perferably be 15 to 22.5 cm. (6 to 9 in.). The sand surface should be level.

(c) Number of beds: Not less than four sludge beds should be provided. The exact number of beds should be based upon the volume of sludge treated. Suitable walls should be provided, not less than 0.3 m. (12 in.) high, above surrounding ground level, and such walls should extend at least 0.40 to 0.45 m. (15 to 18 in.) above the sand surface.

(d) Sludge influent: Sludge influent pipe should terminate at an adequate height over the surface of sand, and should be designed to drain. Splash plates should perferably be provided.

(e) Drainage disposal: Adequate arrangements should be made for safe disposal of drainage from the sludge beds.

General

(a) Adequate flow measuring devices should be provided at all sewage treatment plants. Hydraulic design of the plant should be capable of handling at least 2.5 D.W.F.

(d) Greater attention should be paid to the collection of samples and the provision of laboratory facilities for control of plant performance.

(c) Wherever possible, B.O.D. tests should be preferred to oxygen absorption tests. Temperature of testing should be stated and due corrections applied when comparing the results at different temperatures.

(d) River pollution control work should be given greater attention, and for the larger rivers, Pollution Control Boards should be formed with powers to form 'Effluent Standards', 'River Standards', or both, to suit actual conditions, and thereby help to conserve the total water resources of the country.

Septic tanks

(a) In the absence of sewage systems, septic tanks may be provided only if the water supply is more than 67.5 litres per capita per day (15 gallons per capita per day) and flush toilets are used. Otherwise, aqua privies, pit or borehole privies may be provided.

(b) Septic tanks should be preferbly in two compartments with proper inlet, outlet, baffle arrangements, vent pipes and manholes.

(c) The size of the septic tank should be adequate for the flow to be handled, for the frequency of sludge and scum removal and other relevant factors. Empirical designs in India range from 0.075 to 0.135 m.^{3} (2.5 to 4.5 c.ft.) per capita. The minimum capacity of tank should preferably be 1,350 litres (300 gallons). The larger size tanks should be provided after taking into consideration the requirements of safe disposal of the effluent.

(d) Effluent should preferably be soaked in underground soak pits or absorption trenches of sufficient size. If used for gardening, health hazards should be taken into consideration. Direct discharge into dry water courses or *nallas* should be discouraged.

(e) Septic tanks should be preferably desludged once a year, but, in any case, not later than once in three years. Desludging valves should be provided only in larger tanks. Sludge should be disposed of in a sanitary manner, preferably after drying.

Sewage pumping stations

(a) Sewage pumping stations should have enough capacity to handle maximum estimated sewage flow plus enough additional capacity for infiltration, wherever necessary, to prevent flooding of the station.

(b) All stations should have adequate number of pumping units with sufficient standby capacity. Power standby may be considered wherever necessary.

(c) Wet well capacities should not exceed 20 min. at minimum flow conditions. Dividing the wet well into two compartments, properly interconnected, should be considered to facilitate maintenance.

(d) Pumping stations should be adequately housed and floor drainage from pump room discharged to wet well. Adequate ventilation arrangements should be made.

Sewerage systems

(a) For sewer mains, the minimum size of pipe to be used should be 200 mm. (8 in.).

(b) Grades should be sufficient on all sizes of pipelines to afford preferably a velocity of 1.05 m. per sec. (3.5 ft. per sec.) at 2.5 D.W.F. Maximum velocity should be not greater than 3 m. per sec. (10 ft. per sec.).

(c) Greater attention should be provided to the maintenance and study of rainfall records so that storm sewers could be designed more rationally to provide at least for the two year storm in cities and one year storm in suburban residential areas.

(d) Manholes should be at a maximum distance of 95 m. (150 ft.) apart for pipe sizes upto 0.3 m. (12 in.) diameter and 75 m. (250 ft.) apart for pipes of larger sizes, and should be installed where two or more lines come together or where there is a change in direction, grade or pipe size. Manholes should be waterproofed to prevent infiltration.

(e) Materials used for joining sewer pipes should be of such quality as to ensure a tight root resistant joint when properly placed. Care should be exercised that the interior of the pipe is left in such a condition that free flow is not obstructed.

(f) A minimum coverage of 0.9 m. (3 ft.) over sewers is recommended.

(g) Attention should be paid to the need or otherwise of intercepting chambers and consequent isolation of the ventilation systems of the main sewers and the house drains. In the event of intercepting chambers being provided, suitable vent shafts should be located on main sewers at a maximum distance of 300 m. (1,000 ft.) apart and at least two vent pipes in the house drain system to provide for adequate ventilation.

Reprinting of 'The Life of Sir Arthur Cotton'

The Council of the Institution have decided to reprint the book 'The Life of Sir Arthur Cotton' by Lady Hope, originally published by Holder & Stoughton Ltd., London, in 1900.

The permission of the London publishers to the reprinting of the book has already been obtained. In order to get an idea of the demand for the reprinted copies, the Secretary will be grateful if members will write to him in case they are interested in buying a copy. It is not possible to give an idea of the price per copy at this stage and any order received will be treated as provisional only.

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standard Code of Practice for Construction of Reinforced Concrete Shell Roofs—Doc : BDC 13 (468).

This Standard covers the construction of in-*situ* reinforced concrete shells of single and double curvature, for the guidance of those engaged in the construction of shell roofs.

2. Draft Indian Standard Code of Practice for in-*situ* Construction of Walls in Buildings with Soil-Cement or Rammed Earth—Doc : BDC 13 (533).

This Standard covers in-*situ* construction of walls in buildings with soil-cement or other stabilized soils.

3. Draft Indian Standard Code of Practice for Fixing Wall Coverings—Doc : BDC 13 (431).

This Standard covers the fixing of rigid wall coverings and includes (i) gypsum plaster boards and wall boards, (ii) fibre building boards and paper boards, (iii) plywood and block boards, (iv) chip boards and wood waste boards, (v) asbestos wall boards, and (vi) other miscellaneous types of wall boards (including plastic boards and reed boards).

4. Draft Indian Standard Code of Practice for Construction of Brick-*cum*-Concrete Composite (Madras Terrace) Floor or Roof—Doc : 13 (563).

This Standard covers the design and construction of brick-*cum*-lime concrete composite floor or roof, known as Madras terrace. It covers the construction practices that are in general use in this country.

5. Draft Indian Standard Code of Practice for Construction of Jack Arch Type of Built-up Floor or Roof—Doc : BDC 13 (539).

This Standard covers the construction of jack arch type of built-up floors and construction with brick jack arches in general use in this country.

Members may send their comments on the above draft Standards before November 14, 1961, to Shri T. R. Mehandru (*M.*), 14 Asaf Ali Road, Ajmeri Gate Extension, New Delhi, who is the Institution representative on the Sectional Committee dealing with these draft Standards.

6. Draft Indian Standard Specification for Angle Sections with Legs of Unequal Width and Thickness—Doc : SMDC 6 (320).

This Standard lays down the dimensions of angle sections with legs of unequal width and thickness for use in ship building industry.

7. Draft Indian Standard Specification for Steel Sheet Piling Sections—Doc : SMDC 6 (322).

This Standard lays down the nominal dimensions and shape of hot rolled steel sheet piling sections.

Members may send their comments on the above draft Standards before November 30, 1961, to Shri J. G. Bodhe (*M.*), 24-26 Dalal Street, Fort, Bombay 1, who is the Institution representative on the Sectional Committee dealing with these draft Standards.

Copies of the draft Standards may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; or 2/21 First Line Beach, Madras 1.

Additional list of Referees for Students appearing in Section B of Associate Membership Examination

The following is an additional list of referees to that which appeared in the *Bulletin* dated May 1961.

Gujarat Centre

26. M 2039 T. A. Desai (M, E)
Principal, S.V. Regional College of Engineering and Technology, Majura Gate, Surat.

27. AM 9224 S. C. Rangwala (C)
584 Thengawada, Raipur, Ahmedabad 1.

28. AM 9178 R. K. Vip (M)
Deputy Director (Production), P.T.C. National Small Industries Corporation, Udyog Nagar, Rajkot.

Kerala Centre

20. AM 7214 K. C. Alexander (C)
'Manjalloor House', Kuravankonam, P.O. Kawdiyar, Trivandrum 3.

21. M 2129 T. Balakrishna Menon (C)
Superintending Engineer, Public Health Engineering Department, Palghat.

22. M 2018 A. K. Chacko (C)
Retired Chief Engineer, Theckinmood, Kesava Vilas, Trivandrum 1.

23. M 2120 O. J. Cheriyan (C)
Superintending Engineer, Pamba Hydro-Electric Project, Kottayam.

24. M 2363 T. P. Gopala Menon (C)
23/347 Kannancheri, Kozhikode 3.

25. M 2186 A. J. Joseph (C)
Deputy Chief Engineer, General & Irrigation, P.W.D., Trivandrum.

26 AM 7073 K. R. Madhavan Nair (C)
University Engineer, University of Kerala, Trivandrum.

27. M 1826 A. G. Menon (M)
Additional Chief Secretary to the Government of Kerala, Trinvandrum.

28. M 2359 V. G. G. Nayar (E)
General Manager, Aluminium Industries Ltd., Kundara.

29. M 1496 P. G. Raman Nair (C)
Avuthodu House, Nanthuattu Kunnamu, P. O. Parur, District Trichur

30. M 2003 V. Ranganathan (C)
Chief Engineer (Construction), Kerala State Electricity Board, Trivandrum 1.

31. AM 6926 K. G. Seshan (M, E.)
Assistant Engineer, Kerala State Electricity Board, 413 Chenthittai Street, Trivandrum.

32. AM 6663 M. P. Subramonia Ayyar (C)
Assistant Engineer, P.W.D., 'Padma Vishak', College Lane, Trivandrum 1.

Madhya Pradesh Centre

33. M 2040 N. D. M. Appa (E)
Deputy Chief Engineer, Heavy Electricals Private Ltd., Post Box No. 46, Bhopal.

34. AM 4293 P. R. Aramadhu (C)
Executive Engineer, P.W.D., S-II-27, South T. T. Nagar, Bhopal.

35. AM 4129 S. K. Das (E)
Joint Director of Public Instruction (Technical), Government of Madhya Pradesh, Bhopal.

36. M 1860 Prof. N. R. Das Gupta (M, E)
Head of the Department of Electrical & Mechanical Engineering, G.S.T. Institute, Indore.

37. AM 4514 T. C. Gurbaxani (C)
Executive Engineer, Indore Division No. 1, P.W.D., B. & R., Indore.

38. AM 5112 R. K. Keshava Narayan (C)
Professor of Civil Engineering, Madhav Engineering College, Gwalior.

39. M 2290 Dr. M. Manohar (C)
Professor & Head of Civil Engineering Department, Moulana Azad College of Technology, Bhopal.

40. AM 3276 B. R. Raghavendra Rao (M)
Chief Training Instructor, Heavy Electricals Private Ltd., Govindpur Colony, Bhopal.

41. AM 5961 D. Venkata Rao (C)
8A, Gandhi Road, Gwalior.

42. AM 3205 B. S. Rathore (M, E)
Executive Engineer, Chambal Project, Transmission and Grid Substation Division II, Jyotinagar, Ujjain.

43. AM 5593 S. C. Sharma (C)
Executive Engineer, Public Health Division, Ujjain.

44. AM 2511 G. P. Tiwari (M)
Chief Inspector of Boilers, Madhya Pradesh, Banbag, Indore.

45. AM 2219 P. C. Vasandani (M, E)
G.S. Technological Institute, Indore.

Madras Centre

29. AM 6978 B. Gopalan (E)
Principal, Government Polytechnic, Pondicherry.

30. M 1685 S. L. Narasimha Moorthy (C)
26 Model House Road, C.I.T. Nagar, Madras 17

31. M 1709 G. Venkataraman (C)
Chief Construction Engineer (Retired), Plot No. 40, East Abhiramapuram Extension, Mylapore, Madras 4.

Orissa Centre

11. AM 9000 N. K. Das (E)
Executive Engineer (Electrical), General Electrical Division, Bolangir.

12. AM 9362 U. N. Mishra (C)
Principal, Berhampur Engineering School, Berhampur, District Ganjam.

13. AM 5466 S. M. Panda (M, E)
Executive Engineer (Electrical), Duduma Transmission Division, P.O. Rayagada, District Koraput.

14. AM 4163 B. K. Patnaik (M, E)
'Shanti Nivas,' Puri Ghat Road, Cuttack 1.

15. AM 8021 J. M. Patnaik (E)
Secretary, Orissa Electricity Board, Bhubaneswar.

16. M 2382 C. P. Srivastava (M, E)
Chief Engineer (Electrical & Mechanical), National Mineral Development Corporation, Ltd., Kiriburu Iron Ore Project, P.O. Kiriburu, District Keonjhar.

Poona Centre

46. AM 5131 M. G. Shah (C)
Professor and Head of Civil Engineering Department, Government Engineering College, Karad.

INSTITUTION NEWS

Formation of a Committee to study problem of floods in India

The Council in their 420th Meeting held at Calcutta on September 9, 1961, decided to appoint a Committee to study the problem of floods in India and to submit a report suggesting the outlines of a national policy to be recommended to the Government for the prevention and control of floods.

Opening of a new Sub-Centre at Bhopal

As approved by the Council in their 416th Meeting held in Bangalore on May 10-11, 1961, a Sub-Centre of the Institution was opened at Bhopal, Madhya Pradesh, on July 22, 1961. Shri S. Sarangapani (*M.*) and Shri D. Dhar (*A.M.*), were elected Chairman and Honorary Secretary respectively. The Sub-Centre was inaugurated by Dr. K. N. Katju, Chief Minister of Madhya Pradesh.

The Chief Minister, on arrival, was received by Shri S. Swaminathan (*M.*), Chairman, Madhya Pradesh Centre, and Shri Sarangapani. Delivering the welcome address, Shri Swaminathan said, 'I feel highly honoured in being called upon as Chairman of the Madhya Pradesh Centre to welcome you, Sir, for having so kindly consented, in the midst of heavy demands on your time, to inaugurate the Bhopal Sub-Centre. Your presence here this evening is a source of inspiration and encouragement to us.

The Institution, which is the only professional body in India which embraces all branches of engineering, was established in 1920, and from a modest beginning, it has grown to its present mighty status. It has, for the last four decades, performed a very useful function in bringing together engineers of all ranks from different branches of engineering, in acting as a forum for exchange of information, and in promoting the advancement of science and technology in India. The Institution has a membership of over 28,000, and carries on its activities through 18 Local Centres and 9 Sub-Centres spread over the various States, including Jammu & Kashmir. The Institution *Journal* has established itself as a premier engineering journal in the country. The Institution is represented on various scientific and industrial panels and councils and committees dealing with technical education and other engineering activities. In order to encourage fuller growth of the various branches of engineering through greater autonomy within the Institution, it has been decided to set up seven Division Councils, for civil engineering, mechanical engineering, electrical engineering, mining and metallurgy, electronics and telecommunication engineering, chemical engineering, and general engineering. These Councils will be responsible for technical activities in their respective branches of engineering. The Institution offers opportunity to hard working apprentices to obtain a qualification which is recognized as equivalent to a degree in engineering, and thus fulfils a very important role in the building up of engineering talent in the country.

To popularize the engineering profession and encourage engineering education, the Institution has established the Public Charitable Trust for the Advancement of Engineering Education, under which a number of scholarships were awarded last year. A President's Rupee Scholarship Fund has been started to which each member is requested to contribute one rupee each year.

In the words of Dr. A. N. Khosla, 'The major objective of the Institution is the promotion and pooling of engineering knowledge with a view to developing research and providing experts in all branches of engineering for purposes of investigation, design, construction and operation and thus making Indian engineering and industry mostly independent of foreign consultants and experts.'

Speaking about engineering societies, Mr. Herbert Hoover, a Past-President of the U.S.A., himself an engineer, said, 'The engineering societies are in reality great educational institutions. Within the societies is constant exchange of discoveries, improvements and experiences. Their findings are printed for all the world to see. These societies constitute a gigantic post-graduate course for engineers, which will continue all their professional lives. I have attended this course for more than 60 years with intellectual profit.' The Institution has completed four decades of its existence and our feelings today are of pride in its past achievements and we look forward to a future of greater endeavours.

With the commissioning of the two major projects in the State, the Heavy Electricals at Bhopal and the steel plant at Bhilai, and the consequent concentration of engineers at these centres, the formation of Sub-Centres at Bhopal and Bhilai was approved. The Sub-Centre at Bhopal, will serve the members in the districts of Sihore, Dewas, Indore, Ujjain, Ratlam, Mandasaur, Khandwa, Betual, etc.

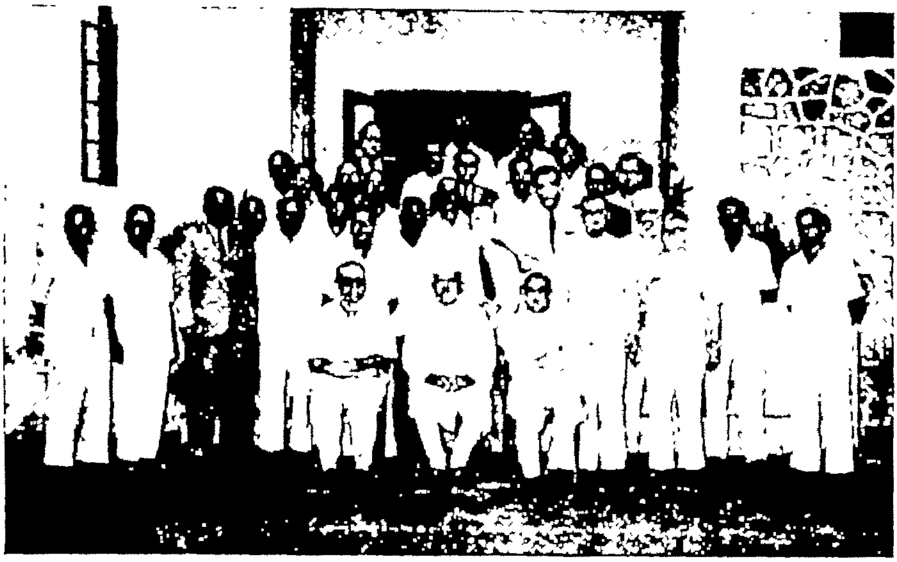
The Madhya Pradesh Centre is very active. Technical papers are read and discussions held on various engineering problems at regular weekly meetings. Technical film shows and visits are also arranged. The Centre conducts special classes for candidates who wish to appear for the Institution examinations. Student Chapters are being started in most of the engineering colleges in the State, where students are encouraged to read papers. The Centre is also trying to organize technical lectures at different places.

At no time in the history of our State has the rate of progress in the technical field been so rapid as at the present time. Therefore, to be successful engineers, it is essential to accept and adopt new techniques and methods, be conversant with the latest developments by attending lectures, exchanging experiences through discussions and keeping in touch with the latest literature on engineering subjects. By joining the Institution an engineer can keep his technical knowledge at a high level and also assist his fellow engineers by imparting to them his own experiences through technical papers. The Local Centre and the new Sub-Centre offer ideal opportunities for this purpose.

One of the important aids to the growth of engineering profession is a good technical library. The Local Centres have such libraries but these are not well equipped for want of finance. It should be the joint effort of the Government and the public to establish fully equipped technical libraries in all important towns. The Prime Minister of Jammu & Kashmir has set a notable example by donating a sum of Rs. 50,000 for the purchase of books for the library of the Jammu & Kashmir Centre. Other State Governments also have sanctioned liberal grants to the Centres in their States for their libraries. I, therefore, take this opportunity of appealing to our State Government through our Chief Minister for grant for equipping the libraries of the Centre at Jabalpur, and also at the Sub-Centres at Bhopal and Bhilai. I also wish to reiterate here the appeal made by our Past-President, Dr. K. L. Rao, to all members, particularly the senior members, to donate one book every year to the library of the Local Centre.

The Institution has a great part to play in the execution of the Plans, In countries like the U.S.A. and the U.K., such institutions are the recognized advisory bodies of the Government. In India, it is time the Government should recognize the value of the collective opinion of a representative body like this Institution. State Governments in Kerala, Bihar, West Bengal and Uttar Pradesh have sought the assistance of the Local Centre in the State in solving important problems confronting them. On behalf of the Centre, I take this opportunity of placing the services of the Centre at the disposal of the State Government and assure them of our full support and cooperation.

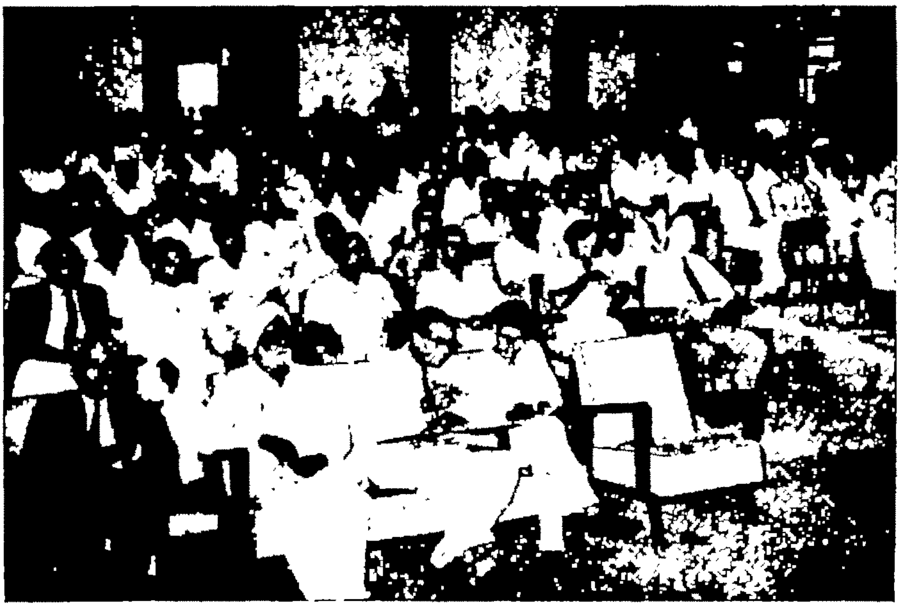
In the execution of the gigantic schemes in the First and Second Plans, great responsibilities devolved upon the engineering profession. The Third Plan makes a demand on a much bigger scale on the creative effort of engineers. Whether a scheme is for improved agricultural production, for increased facilities for communication, for social measures like establishment of schools, hospitals and community projects, or for industrial development, the engineer is called upon to play a formidable part in its implementation. In spite of the shortage of technical personnel, the profession has faced the challenge boldly. In the accomplishment of this task, we can recall with satisfaction the role that members of the Institution played.



DR. K. N. KATJU, WITH MEMBERS OF THE MADHYA PRADESH CENTRE

SHRI S. SWAMINATHAN, CHAIRMAN, MADHYA PRADESH CENTRE, WELCOMING THE GUESTS AND MEMBERS

DR. K. N. KATJU DELIVERING THE INAUGURAL ADDRESS



A SECTION OF THE GATHERING

The engineering profession is in a continuous process of evolution. The present period is of phenomenal progress in innovations in materials, techniques and methods. The need for synchronizing academic instruction with practical requirements is, therefore, greater. The members of the Institution can make valuable contribution towards furthering of technical education and maintaining its standard consistent with the changing needs of the profession.

Both management and the Government have to play a part in affording facilities to the engineer to broaden his outlook and change it to suit the changing times. Every engineer should be encouraged to take part in engineering activities and conferences. Participation in annual conferences, where engineers from all over India meet, is restricted on financial considerations without appreciation of the fact that the extra expenditure on this account will pay good dividends to the State.

The State abounds in natural resources and raw materials necessary for a balanced and self-sufficient economy, which, except for coal and some iron ore, have not yet been tapped or utilized. Both in respect of food and industrial production, we can have surplus for decades to come, which will enable us to export these products not only to adjoining States but also abroad and earn valuable foreign exchange, so necessary to support the large scale planned development of the country. Yet, we have barely touched the fringe of development in the State. With will and wisdom, I see no end to developments.

The rivers in the State open out a large hydro-electric potential and irrigation possibilities. A comprehensive investigation and assessment of the water resources in the State should be undertaken during the Third Plan period and a master plan for the best utilization of the waters prepared to enable projects being taken up during the next Plan. A separate organization should be set up in the State for a complete assessment of the potentialities of the rivers for irrigation and power. This will ensure a coordinated exploitation of the potentialities in furture Plans.'

Shri Swaminathan then thanked the Chief Minister and other invities for attending the inaugural function and requested the Chief Minister to inaugurate the Sub-Centre. Dr. Katju then addressed the gathering in the following words:

'I am most grateful to you for inviting me here on this auspicious occasion and asking me to inaugurate the Sub-Centre of your great Institution at Bhopal. The future of the country lies particularly with the coming generation and one of the noblest works ahead us is the task, call it the re-construction of India or the building of India. It is a magnificent work, and I often envy the younger generation who are responding most bravely to the call of the nation. They are making utmost effort to qualify for rendering service as engineers, medical men, agriculturists, and other technical personnel. I look back upon my younger days when I began life as a student. I was familiar at that time with Uttar Pardesh, and there was only one engineering college, founded many years ago, which is now more than a century old. The number of people who went in for an engineering course was then very limited. Now we have engineering colleges all over India. The demand for the establishment of new colleges is increasing and the students seeking admission are inspired with confidence. This is good for the country because we require thousands of engineers to serve the nation. I am delighted to learn that you have a membership all over India of over 28,000. This is an inspiring information. I hope that this Sub-Centre will prosper greatly, attract more members, and render distinguished service to the community.

You have heard just now an illuminating address. The information which attracted me most was that you were already rendering assistance to students. Fifty years ago, education was confined to a limited circle of people, but now education is everywhere. It has penetrated the rural areas also. It has attracted students from all communities, and the number of meritorious students who may not be able to maintain themselves in expensive engineering colleges is increasing. You are probably better aware than I am, of what the education in an engineering college costs. This may be beyond the means of many people. I am very happy to know that you are assisting them. I wish you good luck and, if I may say so without any impertinence, I would like you to enlarge the sphere of your activities. The State Government has formulated and established a scheme of merit-*cum*-poverty scholarships. I think that is the need of the hour in India.

When this address was being delivered, I was thinking that the engineers of today in India have inherited great traditions, traditions going back to thousands of years. It may be that in those days there was no such thing as chemical or mechanical engineering; but I do not know whether in the field of building and architecture you have surpassed your ancestors. Considering the Taj Mahal and Khajuraho I often wonder how they built these. We condemn the caste system, but I imagine it is the caste system which produced the engineers of those days, as there were no engineering colleges, professors and lecturers. Go to the Sanchi temple, and see the *stupas;* the arches resolve engineering skill. You have inherited all those traditions. Instead of erecting Kutub Minars, you erect 40-50 storeyed buildings, but ornamentation is disappearing, probably it is considered needlessly expensive. But, the students of engineering colleges, when they come out, might like to emulate their ancestors and build another Taj Mahal or memorial which may be a glorious answer to their ancestors.

Your Chairman referred in his address to the anxiety of members to assist the Government in establishing new industries. I welcome that because we look to you for assistance. A modern temple has been built at Gandhisagar where people can see what modern engineers have done. We have built there a large number of buildings, roads and other facilities such as medical, educational, etc. When the construction was in progress, the population there was about 25,000. The Gandhisagar Dam is practically completed. We are discussing proposals to establish an aluminium factory in the State. A power house will be built in the Amarkantak region. I would very much welcome suggestions, schemes and ideas as to the development of industries in those areas, particularly around Gandhisagar.

I think, today, practically every family in India is making its contribution to the engineering profession. I noticed that among the successful candidates for engineering degrees, one or two girls were also included. I am very happy to learn that several girls have taken engineering degrees.

I hope you have a great future before you. This Sub-Centre will expand because, as the Chairman has expressed, we have enormous mineral resources in the State. Our ancestors have left wealth buried underground, in the form mineral resources. It would be for the younger generation to see that these resources are developed. We require skill, attention and development, and we have learnt that there is need for planning on a wide scale.

Every institution the movements of which encourage and develop a spirit of unity in the country is welcome and deserves every encouragement. Every member of your Institution is an Indian first. You may come from any part of India but when you sit down at the Institution of Engineers, you think of the country as a whole, to serve the country and raise it in public esteem. The problems before us are enormous, namely, raising the standard of living of the people, producing more national wealth and to see to its proper distribution. I envy every engineer and medical man because he stands on his own legs and serves the country. The country appreciates you.

I would very humbly and with all modesty suggest that members of your Institution should do their utmost to increase the field of their knowledge. You propose to do it by establishing libraries, by reading papers, books and then referring to the world literature. What an engineer discovers here, you share it with him through books, articles and seminars. But I want that every engineer should also be a lover of the nation and should set in himself a standard of the highest possible conduct so that he may endear himself to the people.

I am very grateful to you for asking me to join you on this auspicious occasion. I happily inaugurate this session and wish you all luck.'

Shri Sarangapani then proposed a vote of thanks in the following words :

'It has been our good fortune to witness the inauguration of the Sub-Centre by our beloved Chief Minister. It has been our privilege to listen to words of mature wisdom and advice from the lips of the distinguished statesman, and I have no doubt that the members of this Sub-Centre will, through their activities in the years to come, show that they have benefited from these wise words. Through the efforts of many of our distinguished predecessors in the last few decades, engineers in this country have made their mark and the profession has come into its own. We also know that the Government has realized it because they are turning more and more to engineers for filling many top managerial positions in the different projects in the country. In turn, it is the responsibility of the engineers to rise to the occasion. It is our duty to see that the works entrusted to us are fulfilled to the best possible standards, but more than that, with utmost economy. We are a poor nation, and much is expected of the country, if most of our people are to have two meals every day. Apart from integrity, which is the first qualification of an engineer, I would respectfully suggest that economy in construction through research and efficiency in design is most important. It is for us to show by our efforts during the Third and subsequent Plans that we can do the work as efficiently as engineers in other parts of the world. It is my pleasant duty to propose a very hearty vote of thanks to our Chief Guest who has found time amidst his numerous engagements to attend this function and inaugurate the Sub-Centre. I also thank all the friends who have attended the function at great inconvenience and have contributed to the success of this evening.'

FORTHCOMING CONFERENCES

Symposium on 'Mechanization of Mines', Central Mining Research Institute, Dhanbad, December 9-12, 1961

A Symposium on 'Mechanization of Mines' will be held at the Central Mining Research Institute, Dhanbad, from December 9-12, 1961. The Symposium is sponsored by the Central Mining Research Station, the Indian Sub-branch of the Association of Mining Electrical & Mechanical Engineers (Great Britain), and the Journal of Mines, Metals and Fuels. A Mining Machinery Exhibition will also be held simultaneously with the Symposium.

Further details regarding the Symposium can be had from the Honorary Secretary, Symposium Committee, Journal of Mines, Metals & Fuels, 6/2 Madan Street, Calcutta 13.

Seventh Congress on Theoretical and Applied Mechanics, Indian Institute of Technology, Bombay, December 23-26, 1961

The Seventh Congress on Theoretical and Applied Mechanics will be held at the Indian Institute of Technology, Powai, Bombay, from December 23-26, 1961, under the auspices of the Indian Society of Theoretical and Applied Mechanics. Research papers on the following topics are invited for presentation at the Congress:

1. Elasticity, plasticity and rheology.
2. Fluid mechanics (aerodynamics and hydrodynamics).
3. Mechanics of solids (ballistics, vibration, friction and lubrication)
4. Statistical mechanics, thermodynamics and heat transfer.
5. Mathematics of physics and statistics.
6. Experimental techniques.
7. Computation methods.

The papers, accompanied by their copies of abstract, should reach Dr. M. K. Jain, Officiating Secretary, The Indian Society of Theoretical and Applied Mechanics, Indian Institute of Technology, Kharagpur. Further details regarding the Congress can be had from Dr. Jain.

Symposium on 'Ferro-Alloy Industry in India', National Metallurgical Laboratory, Jamshedpur, February 1962

A Symposium on 'Ferro-Alloy Industry in India' will be held at the National Metallurgical Laboratory, Jamshedpur, in February 1962. The exact dates for the Symposium will be announced later.

The scope of the Symposium will include :

(i) Survey of raw materials in terms of metallurgical quality and reserves for the production of different types and grades of ferro-alloys in India, including auxiliary requirements such as fluxes, fuels, electric power, transport, etc.

(ii) Beneficiation of raw materials for indigenous ferro-alloy industry based on physical, chemical and thermal beneficiation techniques, ore dressing cycles, formulation of optimum flow sheets, and assessment of recovery yields and economic data.

(iii) Evaluation of electro-thermal, alumino-thermic, pyro-metallurgical techniques and other specific processes, and developments in the production of different types and grades of ferro-alloys in relation to the possibilities of their applications in India in the context of indigenous resources.

(iv) Study of the basic physico-chemical and thermodynamic principles involved in the production of ferro-alloys, including theoretical studies on slag and metal equilibrium and related fundamental hypotheses.

(v) Latest advances in the production technology of ferro-alloys, considered in relation to laboratory scale, pilot plant and industrial prototype production trials.

(vi) Utilization of by-products obtained in ferro-alloy industries and overall economics of integrated production cycles.

(vii) Standard specifications for different grades of indigenous ferro-alloys based on corresponding specifications of the raw materials needed.

(viii) Present status of ferro-alloy industry in India and future expansion plans thereof to be projected during India's successive Five Year Plans, in the general background of world production trends.

Further details regarding the Symposium can be had from the Director, National Metallurgical Laboratory, Jamshedpur 7.

International Seminar on Automatic Control in Iron and Steel Industry, Brussels, February 19-21, 1962

The International Seminar on Automatic Control in Iron and Steel Industry will be held in Brussels from February 19-21, 1962. The Seminar will be sponsored by the Communauté Européenne du Charbon et de l'Acier, the Belgian Ministries of

Economic Affairs and National Education, and by the Groupement des Hauts-Fourneaux et Aciéries Belges.

The aim of the Seminar is to convene experts in the fields of iron and steel industry and automatic control from different countries for dissemination of the knowledge of processes and latest methods of automatic control.

Further details regarding the Seminar can be had from the Secrétariat, Permanent de l'Institut Belge de Régulation et d' Automatisme, 98 Chaussée de Charleroi, Brussels 6.

The Second Chemical and Petroleum Engineering Exhibition, London, June 20-30, 1962

The Second Chemical and Petroleum Engineering Exhibition will be held at Olympia, London, from June 20-30, 1962.

The Third Congress of the European Federation of Chemical Engineering will also be held during the Exhibition, which will include symposia on 'Process Optimization', 'Interaction between Fluids and Particles', 'Handling of Solids', and Physics and Chemistry of High Pressures'.

Further details regarding the Exhibition can be had from 'Engineering in Britain', 34 Victoria Street, London S.W.1.

LIST OF NEW ELECTIONS AND TRANSFERS

(*Continued from Bulletin for July* 1961)

MEMBERS

No.	Name	No.	Name
2364	Thakur Pyare Lal Sinha	2380	Nikhileswar Sanyal*
2365	Tiruvottiyur Muniswami Shivram	2381	Kumarendra Bose*
2366	Manohar Lal Sood	2382	Chandraman P. Srivastava
2367	V. K. Mukundan	2383	Bhupendra Nath Banerjee*
2368	Lt.-Col. Siri Niwas Punj	2384	Bijoy Kumar Dhar Roy*
2369	Richard Frank Koken	2385	Krishnanand Sinha*
2370	Golok Chandra Sharma	2386	Nil Dhan Mazumdar*
2371	Norman Ellis	2387	Oyity Thavorath Raghavan*
2372	Prithvi Nath Wanchoo	2388	Bhaskar Digambar Chaudhary*
2373	Col. Om Prakash Datta*	2389	Nistaran Chakravarti
2374	Dr. Bal Dattatreya Kalelkar	2390	Col. Rajendra Nath Kumar*
2375	Lt.-Col. George William Pinto*	2391	Vamulakonda Ramarao
2376	Shiba Shankar Behera*	2392	Herbert Samuel Hart*
2377	Lt. Pamulapati Lalitendra Nath Choudary*	2393	Hanumant Keshav Tulpule*
2378	Krishnaswamy Sitaraman*	2394	Hari Charan Kar*
2379	Prof. V. Sundaresaayyer Jayaraman*	2395	Sanganbasappa Mallangowda Patil*

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* Transferred from Associate Member

MEMBERS (*contd.*)

No.	Name	No.	Name
2396	Manavasi Ramaswamier Visvanathan*	2411	Maneklal Meghraj Bilaney*
2397	Chaman Lal Batra	2412	Chitta Ranjan Pal*
2398	Lt.-Col. Kalidindi Rajanraju	2413	Prof. Mangalore Srinivas Pai*
2399	Srinivasaraghava Raghavachari	2414	Anukul Chandra Sen*
2400	Dr. Vasant Madhav Dokras*	2415	Phiroze Hormasji Adrianwalla*
2401	Sorab Edulji Wadia*	2416	Panduba Murarrao Mane*
2402	Ramanna Raja Rao*	2417	Manuel Victor Menezes
2403	Srutiraj Ghosh*	2418	Noshir Jamshedji Masani*
2404	Col. Waryam Singh Ahluwalia*	2419	Bibhuti Bhusan Basu*
2405	Atul Chandra Sen*	2420	Indu Sekhar Banerjee*
2406	Nand Kishore*	2421	Col. Trichinopoly Vadivel Jeganathan
2407	Ravi Datta*	2422	Tinnevelly Sankara Viswanathan
2408	Raj Kumar Nair	2423	M. C. Srinivasan
2409	Prof. Subodh Kumar Ghose	2424	Pundarikaksha Sharma*
2410	Bhagat Ram Gulati	2425	Air Vice-Marshal Harjinder Singh

ASSOCIATE MEMBERS

No.	Name	No.	Name
9047	Siva Pada Chatterji	9070	Har Dayal Srivastava†
9048	Krishna Das Ray‡	9071	Syed Ahmad Hussain Razvi
9049	Bakshi Brijindra Singh	9072	Anil Baran Dalal
9050	Capt. Raghubansh Kumar Mathur	9073	P. Sadashiva Rao
9051	Capt. Vettoor Emmanuel Joseph	9074	Seshadriiyer Arunachalam
9052	Capt. Soshil Chander Jagota	9075	G. V. Anantha Ramiah
9053	Charan Sewak Gupta	9076	Sudhanshu Shekhar Sinha
9054	Mirza Mumtaz Husain	9077	Louis Francis Lima
9055	Capt. Venkatraman Krishna Kumar	9078	K. V. Krishnamurthy
9056	Inumarty Basava Raju	9079	Bhagwant Dattatray Dani
9057	Krishna Chandra Chatterjee	9080	Capt. Candathiltharayil Koshy Babukutten
9058	Goure Dickshit	9081	Capt. Sukhdip Singh Grewal
9059	Radhakrishin Tillumal Chellani	9082	Lalchand Pranjivan Valera
9060	Gautamkumar Ghosh†	9083	Vedagarbha Narasimha Bindu Madhav Rao
9061	Chidambaram Ramakrishnan	9084	M. V. Badarinarayana Setty
9062	Digindra Nath Dutt	9085	Hampapur Rangaiengar Ramanna
9063	Rajendra Lal Agarwal	9086	Yellappa Devaji Rao
9064	Sivasailam Daivamani‡	9087	Bangalore Munirajappa Rajasekhara
9065	Madhukar Vishwanath Panse†	9088	Lt. Kanagala Satyanarayana
9066	Narayanan Venugopal	9089	Capt. Vadakepat Ramanunni Menon
9067	Sundararajan Vijayaraghavan‡	9090	Capt. Rajeshwar Prasad Srivastava
9068	Oruganti Sundaresaiya	9091	Capt. Harbans Singh Jaggi
9069	Mohan Lal†	9092	Maj. Rajagopala Ranganathan

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* Transferred from Associate Member

† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
9093	Bhavani Prasad Misra
9094	Bhabes Chandra Rath
9095	Aspi Rustom Sethna
9096	Raghbir Singh Sandhu
9097	Baldev Prasad Mohanty
9098	Sunil Kumar Mukerji
9099	Sarpangal Narayana Bhat
9100	Capt. Hardayal Singh Khara
9101	Vadapalli Venkata Narayana Sarma
9102	Pesi Perozshaw Bhote
9103	Amarendranath Biswas
9104	Niranjan Lal Sharma
9105	Samudrala Sita Ram Anjaneyulu†
9106	Annamaraju Seshagiri Rao†
9107	Narahari Keshav Murty‡
9108	Wasantrao Daulatrao Paraskar‡
9109	Maj. Sankar Narayan Viswanath
9110	Unninair Chandu Nair
9111	Augustine Luck
9112	Sadanand Vithal Kasargod
9113	Atmaram Shantaram Punalekar
9114	Subrahmanyam Srinivasan
9115	Gopala Krishna Menon
9116	Capt. Prem Chand Goyal
9117	Capt. Krishan Kumar Kapur
9118	Pramod Anand Paranjape
9119	Sankaranarayanan Ramachandran
9120	Flt.-Lt. Gurudas James Madura
9121	Flt.-Lt. Vasant Janardan Karve
9122	Satyendra Mohan Guha Biswas
9123	Capt. Sadashive Govind Tamaskar
9124	Mohan Madhav Dandekar
9125	Maj. Mahesh Chandra Rawat
9126	Capt. Amiya Ranjan Chakraborty
9127	Yoginder Paul Mayer
9128	Udipi Vasudeva Rao
9129	Minoo Jehangirji Bharucha
9130	Kersi Rustomji Lakdawala
9131	Bhavan Baburao Shinde
9132	Lt. Ganesh Vishnu Sovani
9133	Capt. Rajkumar Singh Bhatia
9134	Gajanan Maheshwar Vaidya
9135	Kailash Chandra Jain
9136	Flt.-Lt. Pavoor Sankaner-Subramanian
9137	Rajaram Govind Joshi
9138	N. R. Anantha Ram
9139	Lt. Manohar Mohaniraj Paranjape
9140	Melville Francis Mendes
9141	Capt. Brij Mohan Khanna
9142	Narain Nebhraj Thadani
9143	Capt. Brat Pal Bhandari
9144	Vithal Vinayak Kothare
9145	Paraki Ramachandraran Narayan Rau
9146	Ramasubramanian Gayatrivallabhan Govindrajpuram
9147	Lt. Vallabhajosyula Suryanarayana Murthy
9148	Nanjappa Shanmughasundaram
9149	Shyam Sunder Vyas‡
9150	Ranajit Kumar Sarkar
9151	T. Itty Varghese†
9152	Girish Chandra Sinha
9153	Lakkuvalli Narayanajois Divakar
9154	Arakere Subba Rao Kesava Murthy
9155	Mahalingeshwar Channappa Kudari
9156	Anand Swarup Agarwal
9157	Sita Ram Jain
9158	Sita Ram Sharma
9159	Sheo Nandan Prashad
9160	Sunil Ranjan Chakraborty
9161	Capt. Divaker Sharma
9162	Deo Nath Mehta
9163	Capt. Rajendra Kumar Jain
9164	Rama Nath Lahiri
9165	Ramanath Narayan Swamy
9166	Satya Prakash Gupta
9167	Ramnarayan Sen‡
9168	Asit Ranjan Kar
9169	Amit Kumar Banerjea
9170	Dhruba Kumar Sen
9171	Tushar Kanti Dutta Munsi
9172	Gokhare Subbiah Sreekantiah
9173	Amalendu Saha
9174	Barendra Mohan Sen
9175	Santosh Kumar Banerjee
9176	Sanat Kumar Ray
9177	Prabir Kumar Roy Choudhuri

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† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (contd.)

No.	Name
9178	Rajinder Kumar Vij†
9179	M. Viswanathan
9180	Sanat Kumar Niyogi
9181	Anil Chand Dutta
9182	Anala Krishnarjuna Rao
9183	Rajinder Singh Mathur
9184	Capt. Lalit Mohan Misra
9185	Capt. Jitendra Mohan Thapar
9186	Nimai Chandra Sen
9187	Bhagwan Shewaram Mirchandani
9188	Bantwal Anantha Baliga
9189	Satyendra Chandra Chakraborty
9190	Bidyut Kumar Chatterjee
9191	Capt. Ombir Singh
9192	Capt Manohar Ganeshrao Arur
9193	Capt. Sudhir Ranjan Sen
9194	Flg.-Off. Gopala Sukumara Panicker
9195	Capt. Puran Singh Brar
9196	Capt. Arunachalam Palaniappan
9197	Man Mohan Sud
9198	Plt.-Off. Conjeevaram Rajaratnam Mohan Raj
9199	Capt. Ananthan Sesha Iyer
9200	Capt. Man Mohan Kumar
9201	Yenuga Venkata Subbareddy
9202	Jakka Ranganayakulu
9203	Kamaraju Venkata Narasimha Rao
9204	Penmetsa Krishnam Raju
9205	Nimmagadda Madhusudana Rao
9206	Chunduri Sree Ramachandra Rao
9207	Gudavalli John Wycliffe
9208	Guruju Krishnaji
9209	T. Narayana Rao
9210	Tata Kameswara Rao
9211	Thiruvenkatachary Parthasarathy
9212	Dr. Sarat Kumar Baruah
9213	Dinkar Yeshwant Mohgaonkar‡
9214	Subhash Chandra Ghosh
9215	Kanchanlal Bhailal Mehta
9216	Gulab Naraindas Bhavnani
9217	Flt.-Lt. Prabhakar Lakshmidas Ghate
9218	Lt. Mandikal Shankaranarayanarao Ananda Rao
9219	Hasmukhlal Gulabdas Saraiya
9220	Jashbhai Govindbhai Patel
9221	U. Bheemarao Sreepada Rao
9222	R. Sriram
9223	Capt. Ramesh Chander Beotra
9224	Shantilal Chimanlal Rangwala
9225	Nyayapathi Sri Venkateswara Row
9226	Ratilal Mohanlal Parikh
9227	Kashinath Sadashiv Joshi
9228	Balabhadruni Mallikarjuna Rao
9229	Sreeram Punnaiah
9230	Adusumilli Venkateswara Rao
9231	Sadashiv Gopal Sathaye
9232	Shankar Parshuram Garu
9233	Flt.-Lt. Shashikumar Samuel Ramdas
9234	Lakkhi Ram Govil
9235	Bhalachandra Gangadhar Tilak
9236	Ved Prakash Dewan
9237	Capt. Harbaksh Singh Sodhi
9238	Bokkahalli Subbaiah Basavarajaiah
9239	Mandyamkoppel Puttaiah Chowdiah
9240	Lakkaraju Venkata Krishna Rao
9241	Harish Kumar Jain‡
9242	Venkataramanappa Krishna Raju
9243	Amitabha Banerjee
9244	Salil Chandra Lahiri
9245	Capt. Pramod Vasudeo Chandratreya
9246	Sadhuram Laxmidas Patel
9247	Sunil Kanti Bhattacharji
9248	Dayanand Balasaheb Deckha
9249	Mandyam Bheemarayan Varada Rajan
9250	Bhasker Thakorbhai Patel
9251	Ganjigunte Ramaiyer Ranganatha Iyer
9252	Capt. Tejendra Singh Rekhi
9253	Capt. Manohar Singh Syal
9254	Adi Manekshaw Cooper
9255	Murari Lal Gupta
9256	Lt. Sharad Prabhakar Taggarse
9257	Sharadchandra Purushottam Atre
9258	Capt. Bhupinder Nath Kumar
9259	Suresh Chand Agarwala
9260	Om Parkash Dhir
9261	Jit Lal Minocha

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† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
9262	Venkatesha Nayak Sujeer
9263	Nowenly Rynjah
9264	Prem Narayan Pathak†
9265	Vashishtha Prabhulal Bhatt
9266	Hari Darshan Singh Sidhu‡
9267	Gopeswar Tah
9268	Vasala Pentiah
9269	Yashwant Dhondo Pendse
9270	Ramashrya Roy
9271	Swaroop Narain Sharma
9272	A. Sangappa
9273	Bishamber Dayal Shandilya
9274	Awtar Singh Bhatiani
9275	Sankarapillai Jayadevan†
9276	Kazuyoshi Kawata
9277	Kripal Singh Dhillon‡
9278	Capt. Raja Ram Singh
9279	Manyapanda Ravi Ganapathi
9280	Vishwanath Basalingappa Barhanpure
9281	Satya Narayan Singh
9282	Sukumar Mallik
9283	Pradip Kumar Gupta
9284	Manoharlal Mathur
9285	Amlan Kusum Dutta†
9286	Cheeyakapuvanda Bhimaya Ayapa
9287	Rudra Nath Dutta
9288	Keshava Prasad Tiwari
9289	Ramji Das Agrawal
9290	Nripati Prasanna Roy Choudhury
9291	Manu Gopal Dey
9292	Gul Mangharam Kirpalanee
9293	Tilak Raj Chopra
9294	Dipti Nath Das Gupta
9295	Narinder Singh‡
9296	Capt. Raj Kumar Ghai
9297	Capt. Murari Lal Gupta
9298	Tella Tirupataiah
9299	Kadayam Rambhadra Ramachandran
9300	K. N. Rajamanickam
9302	Probal Gupta
9303	Flt.-Lt. Mahadev Kishore Kulshreshtha
9304	Capt. Gyaneshwar Singh Sood
9305	Koyamangaleth Madhavan
9306	Capt. Basant Mullick
9307	Capt. Vikram Wadhawan
9308	Venkatraman Shanti Kumar
9309	Shaikh Akhtar Wakeel
9310	Tatineni Kondala Rao†
9311	Probodh Narayan Vijayvergiya‡
9312	Ram Chandra Prasad
9313	Subodh Kumar Upadhyay
9314	Ajit Singh†
9315	Domalpalli Rajendra Kumar
9316	Narayan Chandra Roy
9317	Sudhangshu Nandi
9318	Dinanath Mukhopadhyay
9319	Raghuvir Bahadur Asthana
9320	Ujjal Chandra Ghose
9321	Awadhesh Panday
9322	Banshidhar Sarangi
9323	Tamirisa Venkatacharyulu
9324	Capt. Brij Mohan Kalra
9325	Bhulabhai Lallubhai Patel
9326	Akhey Raj Mathur
9327	Capt. Satish Chandar Taxali
9328	Capt. Surendra Mohan
9329	Capt. Jugraj Singh Kahai
9330	Partap Singh
9331	Capt. Karnail Singh Sandhu
9332	Capt. Kamalakar Karunakar Karayi
9333	Capt. M. Mathew
9334	Velchur Sreeramulu Chetty
9335	Saumitra Krishnarao Mullarpattan
9336	Maj. Trilok Nath Bali
9337	Cattamanchi Deivanuja Reddy
9338	Capt. Sudershan Kumar Lamba
9339	Lt. Makarand Ganesh Sathe
9340	Capt. Rup Dayal Mehra
9341	Nagalapur Krishnamoorthy Ramaswamy
9342	Rabindra Nath Ganguly
9343	Amiya Kumar Mukherjee
9344	Manoj Mohan Sen
9345	Sankar Nath Basu
9346	Capt. Chitra Prakash Malla‡
9347	C. Ramanathan
9348	Dhirendra Mohan Mukherjee

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† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
9349	Sushil Kumar Kapur‡
9350	Satyaki Basu
9351	Krishna Bhagwan Srivastava†
9352	Harbhajan Singh Bhatia
9353	P. Natesapillai Murugesan†
9354	Gulshan Bir Singh‡
9355	Purushottam Balkrishna Sapre‡
9356	Balwant Singh
9357	Nadikerianda Somiah Deviah†
9358	Pritam Chand Bansal†
9359	M. Shabbir Ahmad
9360	Sailesh Chandra Chakraborty
9361	Adangapurathu Abraham Philip
9362	U. N. Misra
9363	Dharam Pal Singh†
9364	Parimal Kisor Roy
9365	Behram Burjorji Engineer
9366	Raghavanpillai Ramachandran Nair
9367	Naresh Kumar Sinha
9368	Swatantra Singh Kothari
9369	Maj. Iqbal Singh Anand
9370	Pullarcot Anchakalavan Kumaran
9371	Capt. Jagdamba Prasad Thapliyal
9372	Vadakepat Ramanmenon Radhakrishnan
9373	Gajanan Singhal
9374	Capt. Baldev Kumar Bhandari
9375	Parimal Chaudhuri
9376	Srinivas Prasan
9377	Krishna Dass Dutta
9378	Chandi Charan Mallik
9379	Basanti Prasad Ghosh
9380	Ramchandra Becharbhai Patel
9381	Nirmal Kumar Guha Roy
9382	Ranchhodbhai Chhagandas Patel
9383	Dr. Pranab Kumar Chaudhuri
9384	Chennupaty Satyanarayana
9385	Sankaranarayanan Shanmugham
9386	Aurmilli Gangaiah
9387	Chandulal Maganlal Hazari
9388	Bindiganavle Srinivasan
9389	Capt. Sohan Singh Gill
9390	Subramaniam Viswanathan
9391	A. Subramaniaiyer Muthuswamy Iyer
9392	Nandimandalam Chend Raju
9393	Capt. Harihara Subramanian
9394	Narasimhiahreddy Naranarayana Reddy
9395	Dilip Kumar Ray
9396	Kalakoti Sadasiva Venkata Basivi Reddy
9397	Anandrao Nanasaheb Suryavanshi
9398	Donthireddy Bala Duggi Reddy
9399	Veeramachaneni Satyanarayana Rao
9400	Capt. Rayadrug Sampath Kumar Tatachari
9401	Mohan Devarao Kallianpur‡
9402	Jung Bahadur‡
9403	Manikrao Parootappa Khanapure‡
9404	Jnanamoy Majumdar‡
9405	Capt. Satya Paul Sibal
9406	Imchaba Lanu Toy
9407	Kantilal Jagivandas Bhatt
9408	Shantilal Narsidas Mistry
9409	Becharbhai Kalidas Khatri
9410	Capt. Mohinder Singh Kahlon
9411	Capt. Kapil Mehra
9412	Colattur Narayanan
9413	Saran Singh‡
9414	Capt. Ashok Raj Anand
9415	Monohar Dinker Paranjape
9416	Capt. Bhaskar Purushottam Upasani
9417	Kadaba Narasimhaiengar Srinivasan
9418	Prasanta Kumar Banerji
9419	Royal Vasudeva Reddy
9420	Capt. Mir Sulaiman Ali Khan
9421	Capt. Bhim Bahadur Singh Karki
9422	Flt.-Lt. Dayanand Chilkoti
9423	Capt. Appu Ramananda Sharma
9424	Gorantla Lakshmaiah
9425	Anant Gopal Chaphekar
9426	Rangaswamyiyengar Ananthakrishna‡
9427	Yagya Dutt Misra
9428	Brijendra Kumar Govil
9429	Prasanna Kumar
9430	Mohanarangam Kothandaraman†
9431	Dattatraya Appaji Deshmukh
9432	George Thomas
9433	Basavaptna Subbarao Srinivasa
9434	Ayalur Seshaier Sivarama Krishnan

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† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
9435	Molahalli Subbanna Shetty
9436	Capt. Trichy Venugopal Manoharan
9437	Harivadan Lallubhai Parikh
9438	Indupur Siddaramappah Somashekara
9439	Fg.-Off. Raizur Rahman Kidwai
9440	Sadashive Dinkar Kekre
9441	Capt. Nelluvai Ramanathan Rama Sharma
9442	Tejinder Singh
9443	Bipinchandra Bhalchandra Nanavaty
9444	Channapatana Krishnaswamy Sunder Babu
9445	Bangalore Laxminarasimhiah Rama Rao
9446	Capt. Anthony Joaquim Pinto
9447	Buddhadev Dasgupta
9448	Amal Chandra Sarkhel†
9449	Anil Baran Mahanti
9450	Capt. Sistla Gurunath
9451	Ram Prakash
9452	Subramaniam Balakrishna
9453	Vyankatesh Dhondopant Kulkarni
9454	Arjun Dattatraya Kokane
9455	B. Ganapati Pattegar
9456	Annaswamy Doraiswamy
9457	Pranab Kumar Bagchi
9458	Om Dutt Harnal†
9459	Jagdishchandra Jagjiwandas Doshi
9460	Nalamothu Venkaiya†
9461	Kalyan Kumar Banerjee‡
9462	Krishna Mohan Sinha‡
9463	Kironmoy Ghatak†
9464	Bholanath Saikia
9465	Amritlal Kashiram Mehta
9466	Shekhar Prasad Ganguli
9467	Lakkaraju Venkateshwar Rao
9468	Gundappa Lakshmi Narasimiah
9469	Akhileshwaran Krishnan‡
9470	Krishnaji Sadashiv Patwardhan
9471	Kota Vasudeva Keshava Karantha‡
9472	Chandra Prakash Gupta
9473	Krishnamachary Veeraraghavachary‡
9474	Capt. Harbans Lal Kataria
9475	Kartar Himathsing Bhambhani
9476	Krishnaswami Balaraman
9477	Capt. Karnail Singh Pooman
9478	Krishnaswamy Sankaran
9479	Devudu Narasimhasastry Gangadhar
9480	Lt.-Col. Madan Lal Chopra
9481	Kumar Vidyadhar Sardesai
9482	Krishnarajapuram Venkataramanappa Aswathiah
9483	Arun Martand Karnik
9484	Govind Vishnu Joshi
9485	Anand Narain Harkauli
9486	Manmath Sambhuappa Rudrakshi
9487	Khairati Lal Sachdeva†
9488	Surjit Singh Gujral‡
9489	Brij Kishore Datta‡
9490	Kartik Chandra Bhattacharyya
9491	Monotosh Kumar Mukhopadhyay
9492	Lakshmi Kant Jha
9493	Moni Charan Dutta
9494	Hameed Ahmad Alhashmi
9495	S. Gopalkrishna Reddi
9496	Tilak Raj†
9497	Neti Ramanjaneyulu‡
9498	Durgeswar Talukdar
9499	Lt. Peshori Lal Sharma
9500	Shiv Kumar Bhargava
9501	Dilip Kumar Kundu
9502	Vyasa Venkatasubba Rau
9503	Nallappareddiar Muthu Reddy
9504	Magan Mal Mehta
9505	Sant Sagar Jain
9506	Mysore Srikantapandit Anantha Swamy
9507	Sunil Kumar Ray
9508	Kenneth Knowles Shackell
9509	Sitansu Kumar Banerjee
9510	K. E. Mathew
9511	Mohan Yeshwant Sabnis
9512	Anant Govind Kalgaonkar
9513	Shambhu Nath Bhattacharyya‡
9514	Charles John Stamp Branscombe
9515	Narayan Chandra Das Gupta
9516	Damodar Sarvotham Shenoy
9517	Bhalchandra Shankar Phadke‡
9518	Sannasi Govindaraj
9519	Suresh Shankar Nadkarni

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† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name	No.	Name
9520	Subrahmanya Venkatesan	9544	Manohar Balaji Mande
9521	Vembar Ramakanthan	9545	Ramanlal Manilal Suthar
9522	Walaja Perumal Vijayaraghavan	9546	Hullahalli Gopalakrishnamachar Ranganatha Chakravarthy
9523	Prjush Kumar Singha Roy‡	9547	Prasanta Chandra Sen‡
9524	Menta Venkata Raghavaiah	9548	Shripad Vishvanath Madgavkar
9525	Vilaschandra Valchand Shah	9549	Flt.-Lt. Arwind Gangadhar Wannere
9526	T. Gambudas Srinivasa Rau	9550	Laxmidas Velji Popat
9527	Syed Ziauddin Ahmed	9551	Vinayak Laxman Datar
9528	Jackson Gnana Chandra	9552	Shriram Vishnu Lele
9529	Dabbir Manmath Patnaik	9553	Capt. Mohinder Singh Gill
9530	Arttabandhu Jena	9554	Capt. Surinder Singh Bonsor
9531	Flg.-Off. Mohinder Kumar Bidani	9555	Capt. Avtar Singh Berar
9532	Chiranjib Kumar Sarkar	9556	Flt.-Lt. Shashi Kumar Nangia
9533	Prem Prakash Chawla	9557	Ved Swarup Gupta
9534	Capt. Amarjit Singh Kahlon	9558	Capt. Ranbir Mohan
9535	Capt. Yashwant Deva	9559	Ram Krishna Banerjee
9536	Tejeshwar Prasad Hajela	9560	Krishnappa Nanjundiah
9537	Capt. Mallapur Chandrakanth Rao	9561	Om Prakash Gupta
9538	Bhalchandra Ramkrishna Karnik	9562	Gobinda Mohan Bhattacharya
9539	Capt. Bhola Nath Malhotra‡	9563	Madhusudan Ganesh Jog
9540	Parandur Krishnamachari Rajagopalan	9564	Madireddi Bala Gangadhara Tilak
9541	Bijan Krishna Majumdar‡	9565	Sat Deva Dariya
9542	Rangachariar Padmanabhan‡		
9543	Capt. Narendra Nath Sharma		

GRADUATES

No.	Name	No.	Name
1252	Narayanapillay Viswanathan Nair†	1268	Rajendra Prasad Singh
1253	Nityananda Chakraberty	1269	Sub-Lt. Subramaniam Rajan
1254	Roop Chand Khera†	1270	Kallianpur Ramadas Shenoy
1255	Ram Swaroop Yadava†	1271	Swadesh Kumar Sethi
1256	Sumangali Vaidyanatham Srinivasan	1272	Sub-Lt. Jnanendra Nath Roy
1257	Girdhari Lal Vaishnavi	1273	Jain Swarup Jain
1258	Bhagawan Gajanan Londhe†	1274	Amrik Singh
1259	Krishin Shamdas Irani†	1275	Gopal Kauromal Makhijani†
1260	Hukam Chand Kaushik	1276	Maneck Behramji Daruwalla†
1261	Virendra Nath†	1277	Rajendra Kumar Varma†
1262	Sewraj Kumar Bajaj†	1278	Kandaswamy Soundararajan†
1263	Jiten Banerjee	1279	Darshan Singh†
1264	Roshan Lall Gupta	1280	B. Sundaresamudaliar Kumaraswamy†
1265	Jagdish Chandra Madan	1281	Ish Kumar Aneja†
1266	Kersy Faramji Tata	1282	Flt.-Cdt. Sujash Kumar Baine†
1267	Devidas Dattatraya Date	1283	Aravamuthan Santhanam

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† Transferred from Student

‡ Transferred from Graduate

TECHNICAL FORUM

The Editor,
Journal of the Institution of Engineers (India)

Sir,

Proposal for a new engineering curriculum

The rapid industrialization envisaged in the Third Plan will require thousands of engineers for sales and administration in different industries. Although the Government is opening a large number of engineering colleges which may actually be more than necessary, but none of them offers any suitable degree course for sales and administration. All the courses offered are rather specialized, *e.g.*, civil, mechanical or electrical engineering, and the persons undergoing such courses are suitable for maintenance, design and development works in their respective specialized fields. Management and sales requires a broader training not only in different engineering subjects but also in psychology, law, and the like. Although some institutions offer short term courses in industrial engineering, they are far short of demand.

To produce efficient personnel for management and sales, courses in 'General Engineering' leading to a Bachelor's degree are offered in different universities in the U.S.A. and other advanced countries. Introduction of similar courses in our engineering colleges is urgently called for. A skeleton curricula for a proposed five year integrated degree course (after higher secondary) is given herewith.

First, second and third year

Same courses as in electrical engineering.

Fourth year

Courses in industrial psychology, civil engineering (roads, railways, water supply, etc.), workshop theory and practice, prime movers, theory and perfomance of electrical machines.

Fifth year

Industrial and labour relations, industrial management, economic organization, commercial law, electron tube circuits and engineering electronics, hydraulic machinery, and one elective subject such as sales, publication or any other.

Almost all the subjects mentioned above are already taught in some course or the other in big institutes such as Indian Institute of Technology, Kharagpur. Introduction of such curricula in these institutes will not incur much extra expense. I hope this note will receive due consideration from the authorities concerned.

B. Chatterjee
Communication Engineering Department,
Indian Institute of Technology,
Kharagpur

CORRIGENDA

TO VOL. 10, NO. 11, JULY 1961

Page 26. List of New Elections and Transfers. Instead of '27779 Govindraghavan Samapath', please read '27779 Govindaraghavan Sampath'.

Page 40. 'List of New Elections and Transfers. Instead of '28945 Baldev Roy', please read '28945 Baldev Raj'.

TO VOL. 10, NO. 11, SEPTEMBER 1961

Page 12, Instead of 'Chairman's Address by Shri S. S. Swaminathan, B.E., M.I.E., at the Second Annual General Meeting of the Centre on January 8, 1961', please read 'Chairman's address by Shri S. S. Swaminathan, B.E., M.I.E., at the Second Annual General Meeting of the Centre on February 1, 1961'.

Due to unavoidable circumstances, publication of the following papers, scheduled for publication in *Journal*, vol. 11, no. 1, pts. CI 1 and EM 1, September 1961, the summeries of which appeared in *Bulletin*, vol. 11, no. 1, September 1961, had to be withheld. These papers will be published in the next issue of the respective Parts of the *Journal*.

1. Edge Disturbance in Circular Cylindrical Shells. S. K. Mallik. *Non-member.*
2. Design Procedure for Very Wide Band Distributed Amplifiers. S. C. Nath, *Non-member.*

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATION WANTED

INDUSTRIAL ADVISER, PRODUCTIVITY SPECIALIST, EXECUTIVE, highly qualified in electrical and industrial engineering with diversified experience in different industries and institutions, having worked as Industrial and Management Consultant in an international firm of consultants, and advised many leading organizations in the private and public sector, including Government, is available for full/part time services on reasonable terms. (Office ref. E.S. 94).

SITUATION VACANT

Engineering firm at Bombay requires the services of a consulting engineer for their items of manufacture, such as compressors, vibrators, pneumatic accessories, etc. (Office ref. E.S. 96)

THE BULLETIN

OF

The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D I C., M.Sc.(Eng.), M.I.E.

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PROGRAMME

forty-second annual convention

CALCUTTA
FEBRUARY 1-8, 1962

Maj.-Gen. Harkirat Singh
President 1960-61 and President-Elect 1961-92

42ND ANNUAL CONVENTION
CALCUTTA
FEBRUARY 1-8, 1962

The 42nd Annual Convention of the Institution will be held in Calcutta between February 1-8, 1962.

The Bengal Centre of the Institution will be the hosts on this occasion and are making all the necessary arrangements for a successful Convention and to make the stay of the delegates as enjoyable as possible.

THE ANNUAL GENERAL MEETING

Business Session

The Business Session of the 42nd Annual General Meeting will be held between 3.00 p.m. and 4.00 p.m., on February 3, 1962, at Rabindra Smaranee, junction of Lower Circular Road and Gokhale Road.

Results of election of the President, members of the Council, and Sectional Chairmen for 1961-62 will be announced at this Session.

Inaugural Session

The Inaugural Session of the 42nd Annual General Meeting will be held at 9 a.m. on Sunday, February 4, 1962, at Rabindra Smaranee, junction of Lower Circular Road and Gokhale Road. Dr, B. C. Roy, Chief Minister of West Bengal, will inaugurate the Session.

Paper Meetings and Symposia

Paper Meetings and Symposia will be held at the Academy of Fine Arts, Cathedral Road, on February 5, 6 and 7, 1962, and the detailed programme is given on pages 11-15.

PROGRAMME

Thursday, February 1, and Friday, February 2, 1962

12.00 noon to 5.00 p.m.	Registration of local members at Bengal Centre's Office, 8 Gokhale Road

Saturday, February 3, 1962

9.00 a.m. to 1.00 p.m. 2.00 p.m. to 4.00 p.m.	Registration of outstation members at Rabindra Smaranee, junction of Lower Circular Road and Gokhale Road
2.30 p.m. to 3.00 p.m.	Adjourned Meeting of the 1960-61 Council

3.00 p.m. to 4.00 p.m.	Business Session of the 42nd Annual General Meeting, Rabindra Smaranee
4.30 p.m.	At Home
6.00 p.m.	Cultural programme, Rabindra Smaranee

Sunday, February 4, 1962

9.00 a.m. to 1.00 p.m.	Registration of outstation members at Rabindra Smaranee
9.00 a.m.	Inaugural Session of the 42nd Annual General Meeting, Rabindra Smaranee
10.30 a.m.	Tea
11.00 a.m.	Fifth Sir M. Visvesvaraya Lecture (Name of the Lecturer will be announced later.)
1.00 p.m.	Fellowship Lunch, Dinner Pavilion adjacent to Rabindra Smaranee
2.30 p.m.	Film show
2.30 p.m.	Meeting of the 1961-62 Council, Institution Building, 8 Gokhale Road
4.00 p.m.	Tea
4.00 p.m.	Students Session, Rabindra Smaranee
8.00 p.m.	Annual Dinner, Dinner Pavilion adjacent to Rabindra Smaranee

Monday, February 5, 1962

9.00 a.m. to 1.00 p.m.	Paper Meetings and Symposia*, Academy of Fine Arts, Cathedral Road Civil Engineering Division Mechanical Engineering Division Mining and Metallurgy Division Electronics and Telecommunication Engineering Division Chemical Engineering Division Structures Group I—Prestressed Concrete Marine Engineering and Shipbuilding Group Nuclear Engineering Group
11.30 a.m.	Tea
11.30 a.m.	Meeting of the Honorary Secretaries of Local Centres
1.00 p.m.	Lunch, Dinner Pavilion adjacent to Rabindra Smaranee
2.30 p.m.	Local visits
7.00 p.m.	Cultural programme, Rabindra Smaranee

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* For details, see pages 11-15

Tuesday, February 6, 1962	
9.00 a.m. to 1.00 p.m.	Paper Meetings and Symposia*, Academy of Fine Arts, Cathedral Road Civil Engineering Division Mechanical Engineering Division Electrical Engineering Division Electronics and Telecommunication Engineering Division General Engineering Division Public Health Engineering Group Roads and Road Transportation Group Aeronautical Engineering Group
11.00 a.m.	Tea
1.00 p.m.	Lunch, Dinner Pavilion adjacent to Rabindra Smaranee
2.30 p.m.	Local visits
Wednesday, February 7, 1962	
8.30 a.m. to 11.00 a.m.	Paper Meetings and Symposia*, Academy of Fine Arts, Cathedral Road Electrical Engineering Division Mining and Metallurgy Division Chemical Engineering Division General Engineering Division Railway Engineering Group Industrial Management and Production Engineering Group Hindi Section
11.00 a.m.	Tea
11.15 a.m. to 1.00 p.m.	Closing Session, Rabindra Smaranee
Afternoon	Free
Thursday, February 8, 1962	Local visits
Friday, February 9, 1962	Departure for outstation tours

PROGRAMME OF LOCAL VISITS

Monday, February 5, 1962	
2.30 p.m.	Start from the Institution Building, 8 Gokhale Road (1) Victoria Memorial (2) Race Course

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* For details, see pages 11-15

(3) Birla Planetarium
(4) Indian Museum
(5) Eden Gardens and Ranji Stadium
(6) All-India Radio
(7) Tagore House
(8) Lakes area

Members will be taken round with halts at some of the places. Charges for the visit will be Rs. 3.00 per head.

Tuesday, February 6, 1962

2.30 p.m. Start from the Institution Building, 8 Gokhale Road. Members will be divided into groups. Members should indicate at least two groups in order of preference. It may not be possible to make any change later. Charge for these visits will be Rs. 3.00 per head.

Group 1
(i) Marine Engineering College, New Taratolla Road
(ii) Kidderpore and King George's Docks

Group 2
(i) Ramakrishna Mission Institute of Culture, Gol Park
(ii) Jadavpur University, Jadavpur

Group 3
(i) National Library, Belvedere
(ii) Horticultural Society Gardens, Taratolla Road
(iii) Works of Indian Oxygen Ltd.

Group 4
(i) Indian Statistical Institute, Barrackpore Trunk Road
(ii) Dakshineswar Temple
(iii) Works of National Tobacco Co. of India, Ltd., Agarpara

Group 5
(i) Bengal Chemical and Pharmaceutical Works, Ltd., Panihati
(ii) Bengal Waterproof Works, Ltd., Panihati
(iii) Structural Engineering Works, Ltd. and Pipe Line, Kamarhati

Thursday, February 8, 1962

8.30 a.m. to 1.00 p.m.
2.00 p.m. to 5.30 p.m. } All-day tour with break for lunch at 1.00 p.m.

Members should indicate their choice for three tours in order of preference. Charges for the tours will be Rs. 6.00 per head.

Tour No. 1

- (i) Fan Factory of Jay Engineering Works, Ltd., Bansdhoni
- (ii) Central Glass and Ceramic Research Institute, Jadavpur
- (iii) National Instrument Factory, Jadavpur
- (iv) Institute of Printing Technology, Jadavpur
- (v) Ramakrishna Mission, Narendrapur

Tour No. 2

- (i) Works of Guest, Keen, Williams, Ltd., Andul Road, Howrah
- (ii) Bengal Engineering College, Sibpore
- (iii) D.V.C. Grid Substation, Andul Road, Howrah
- (iv) Botanical Gardens, Sibpore

Tour No. 3

- (i) Works of Dunlop Rubber Co. (India), Ltd., Sahaganj
- (ii) Works of Tribeni Tissues Ltd., Tribeni
- (iii) Kesoram Rayon, Tribeni
- (iv) Bandel Church, Bandel

Tour No. 4

- (i) Bata Shoe Co. (P), Ltd., Batanagar
- (ii) Birlapur Industries
- (iii) West Bengal Government Exhibition, Taratolla Road

Tour No. 5

- (i) Works of Jessop & Co., Jessore Road
- (ii) Control Tower at Dum Dum Aerodrome
- (iii) Petrol Engine Factory of Shri K. K. Roy, Dum Dum
- (iv) Works of Electrical Machines Corporation (P.) Ltd., Jessore Road
- (v) Pareshnath Jain Temple, Jessore Road

Tour No. 6

- (i) Works of National Insulated Cable Co. of India, Ltd., Shamnagar
- (ii) River Research Institute and Milk Centre, Haringhata
- (iii) Kalyani Township
- (iv) Titaghur Paper Mills, Titaghur

Tour No. 7

- (i) Works of Electric Lamp Manufacturers (India) Ltd., Taratolla Road
- (ii) Works of Metal Box Co. of India, Ltd., Hide Road
- (iii) Works of J. Stone and Co. (India) (P.), Ltd., Taratolla Road
- (iv) Works of Shalimar Tar Products, Ltd., Hide Road

Tour No. 8

(i) Hindusthan Motors Ltd., Uttarpara
(ii) Works of Alkali and Chemical Corporation of (I) Ltd., Rishra
(iii) Works of Indian Aluminium Co., Ltd., Belur
(iv) J.K. Steels, Rishra
(v) Belur Temple

Outstation Tours

All outstation tours will commence after lunch on Friday, February 9, 1962, by bus from the Institution Building, 8 Gokhale Road. Visits will include places on the list given below and will take place on Saturday, February 10 and Sunday, February 11, 1962. Members will return to Calcutta on Monday, February 12, 1962, by noon. Each outstation tour will cost Rs. 80.00 per head, inclusive of all charges. Members should indicate only one tour of their choice.

Tour No. 1. Accommodation at Maithon

(i) Chittaranjan Locomotive Works
(ii) Hindustan Cables, Rupnarainpur
(iii) Maithon Dam and underground Power Station
(iv) Kumardhubi Fire and Silica Works, Kumardhubi
(v) Eagle Rolling Mills, Ltd., Kumardhubi

Tour No. 2 Accommodation at Panchet Hill or Burnpur

(i) Panchet Hill Dam and Power Station
(ii) Indian Iron & Steel Co., Ltd., Burnpur
(iii) Sen-Raleigh Industries of India Ltd., Pagladanga
(iv) Bengal Paper Mill Co., Ltd., Ranigunj

Tour No. 3 Accommodation at Durgapur

(i) Durgapur Steel Works
(ii) D.V.C. Barrage and thermal station
(iii) Durgapur Coke Oven Project
(iv) A.V.B. Project
(v) Central Mechanical Engineering Research Institute
(vi) Coal Mining Machinery Project of Heavy Engineering Corporation

Tour No. 4 Accommodation at Santiniketan

(i) Viswabharati University
(ii) Massanjore Dam and Power Station
(iii) Tilpara Barrage

Notes

1. **Registration fee**

(i)	Corporate Members and Graduates	... Rs. 15.00 each
(ii)	Students	... Rs. 12.00 each

2. **Annual Dinner**

(i)	Corporate Members, Graduates and gentlemen guests	... Rs. 15.00 each
(ii)	Students	... Rs. 10.00 each
(iii)	Lady guests	... Rs. 10.00 each

3. **Visits**

Local

(i)	For each half-day visit	Rs. 3.00 per participant
(ii)	Full day visit	Rs. 6.00 per participant

Outstation

Rs. 80.00 for each participant for one tour only.

4. **Transportation**

A consolidated charge of Rs. 5.00 will be levied for each delegate availing of the transportation arrangements made by the Bengal Centre during the Convention, exclusive of the charges for local visits.

5. **Concession for Ladies**

A consolidated charge of Rs. 15.00 may be paid by each lady accompanying a delegate during the Convention, which will cover all the facilities arranged during the Annual Convention, including the Annual Dinner but excluding outstation tours and hotel charges.

Programme for ladies accompanying members

Saturday, February 3, 1962

9.00 a.m. to 1.00 p.m. 2.00 p.m. to 4.00 p.m.	Registration, and presentation of gifts and badges, Rabindra Smaranee
4.30 p.m.	At Home
6.00 p.m.	Cultural programme, Rabindra Smaranee

Sunday, February 4, 1962

9.00 a.m.	Inaugural Session of the 42nd Annual General Meeting Rabindra Smaranee
10.30 a.m.	Tea
11.00 a.m.	Conducted shopping tour
1.00 p.m.	Fellowship Lunch, Dinner Pavilion adjacent to Rabindra Smaranee

2.30 p.m.	Film show
4.00 p.m.	Tea
8.00 p.m.	Annual Dinner, Dinner Pavilion, Rabindra Smaranee
Monday, February 5, 1962	
10.00 to 1.00 p.m.	Conducted shopping tour
1.00 p.m.	Lunch, Dinner Pavilion, Rabindra Smaranee
2.30 p.m.	Local visits
7.00 p.m.	Cultural programme, Rabindra Smaranee
Tuesday, February 6, 1962	
9.00 a.m.	Visit to Udayvilla, Kamarhati
1.00 p.m.	Lunch, Dinner Pavilion adjacent to Rabindra Smaranee
2.30 p.m.	Local visits (Group 2) (i) Ramakrishna Mission Institute of Culture, Gol Park (ii) Jadavpur University
Wednesday, February 7, 1962	
	Exhibition/Conducted shopping tour (Time to be announced later)
Thursday, February 8, 1962	
All-day local visit	
8.30 a.m.	Start from Institution Building Tour No. 4 or Tour No. 6 (details of tours on page 7)

PROGRAMME OF PAPER MEETINGS AND SYMPOSIA

February 5, 1962, 9.00 a.m. to 1.00 p.m.

Civil Engineering Division

Paper Meetings

(1) Introduction of the new Chairman, Prof. N. S. Govinda Rao (*M.*) by Shri Akshoy Bose (*M.*), retiring Chairman

(2) Address by Prof. N. S. Govinda Rao

(3) 'Flood Plain Zoning' by R. D. Dhir (*M.*) (*Journal*, vol. 41, no. 7, pt. I, March 1961)

(4) 'Some Aspects of Real Property Valuation for Estate Duty' by B. N. Chaudhuri (*M.*) (*Journal*, vol. 42, no. 1, pt. CE 1, September 1961)

(5) 'Density Currents in Reservoirs and Their Simulation in Models' by D. V. Joglekar (*M.*) (*Journal*, vol. 42, no. 1, pt. CE 1, September 1961)

(6) 'Soil Studies for the Design of Foundation of a Sluice' by B. Maitra (*M.*) and H. L. Saha (*Non-member*) (*Journal*, vol. 42, no. 3, pt. CI 2, November 1961)

(7) 'Kosi—A Challenge in River Control' by D. Mookerjea (*M.*) (*Journal*, vol. 42, no. 3, pt. CI 2, November 1961)

Mechanical Engineering Division

(1) Introduction of the new Chairman, Shri T. R. Gupta (*M.*) by Maj.-Gen. S. P. Vohra (*M.*), retiring Chairman

(2) Address by Shri T. R. Gupta

(3) Symposium on 'Machine Tools and Metal Cutting'

Mining and Metallurgy Division

(1) Introduction of the new Chairman, Dr. M. N. Dastur (*M.*) by Dr. J. W. Whitakar (*M.*), retiring Chairman

(2) Address by Dr. M. N. Dastur

(3) Symposium on 'Mine Mechanization'

(4) Symposium on 'Development of Non-Ferrous Metals and Alloys During the Third Five Year Plan'

Electronics and Telecommunication Engineering Division

Paper Meetings

(1) Introduction of the new Chairman, Dr. A. K. Chatterjee (*M.*) by Prof. S. P. Chakravarti (*M.*), retiring Chairman

(2) Address by Dr. A. K. Chatterjee

Details to be announced later.

Chemical Engineering Division

Paper Meetings

(1) Introduction of the new Chairman, Dr. V. M. Dokras (*M.*) by Dr. D. R. Malhotra (*M.*), retiring Chairman

(2) Address by Dr. V. M. Dokras

(3) 'Bokaro Fly Ash for Rihand Dam' by S. K. Jain (*M.*), K. M. Maheshwari (*A.M.*), G. D. Agarwal (*Non-member*), R. K. Misra (*Non-member*) and G. D. Joshi (*Non-member*) (*Journal*, vol. 41, no. 10, pt. CH 1, June 1961)

Further details to be announced later.

Structures Group 1—Prestressed Concrete Development

Paper Meetings

(1) Introduction of the new Chairman, Shri N. N. Purandare (*M.*) by Shri E. A. Nadirshah (*M.*), retiring Chairman

(2) Address by Shri N. N. Purandare

Details to be announced later.

Marine Engineering and Shipbuilding Group

Paper Meetings

Details to be announced later.

Nuclear Engineering Group

Paper Meetings

Details to be announced later.

February 6, 1962, 9.00 a.m. to 1.00 p.m.

Civil Engineering Division

(1) Symposium on 'Role of Reservoirs in the Solution of Flood Problems'

Mechanical Engineering Division

Paper Meetings

(1) 'A Study of Oil Seals and Plea for Standardization' by A. P. Rao (*A.M.*) (*Journal*, vol. 41, no. 6, pt. 2, February 1961)

(2) 'Role of Carbide Grades in Flank Wear Growth' by A. Bhattacharya (*A.M.*) (*Journal*, vol. 41, no. 11, pt. ME 1, July 1961)

(3) 'Some Effects of Welding on Low Alloy High Tensile Construction Steel' by Dr. G. Mukherjee (*Non-member*) and M. G. Nair (*Non-member*) (*Journal*, vol. 41, no. 11, pt. ME 1, July 1961)

(4) 'Mechanics of Blast Flame and its Application to Open Hearth Furnaces—I' by S. G. Mukherjee (*Non-member*) (*Journal*, vol. 41, no. 11, pt. ME 1, July 1961)

(5) 'Construction of Electric Overhead Travelling Cranes' by A. N. Naik (*A.M.*) (*Journal*, vol. 42, no. 1, pt. ME 1, September 1961)

Electrical Engineering Division

(1) Introduction of the new Chairman, Prof. M. V. Deshpande (*M.*) by Shri A. R. Narayana Rao (*M.*), retiring Chairman

(2) Address by Prof. M. V. Deshpande

(3) Symposium on 'Power Supply in India'

Electronics and Telecommunication Engineering Division

(1) Symposium on 'Transistors and Semi-Conductors in Communication and Electronics'

General Engineering Division

Paper Meetings

(1) Introduction of the new Chairman, Shri R. N. Joshi (*M.*) by Shri T. R. Mehandru (*M.*), retiring Chairman

(2) Address by Shri R. N. Joshi

(3) 'Batch Production under Piece Work System' by S. N. Das (*A.M.*) (*Journal*, vol. 42, no. 12, pt. GE 1, August 1961)

(4) 'Noise and Industrial Efficiency—I : the Problem' by H. C. Ganguli (*Non-member*) (*Journal*, vol. 41, no. 12, pt. GE 1, August 1961)

(5) 'Importance of Purchasing and Materials Management for the Success of the National Development Plan' by A. R. Palit (*Non-member*) (*Journal*, vol. 41, no. 12, pt. GE 1, August 1961)

Public Health Engineering Group

Paper Meetings

(1) Introduction of the new Chairman, Shri R. S. Mehta (*M.*) by Shri K. B. Carnac (*M.*), retiring Chairman

(2) Address by Shri R. S. Mehta

(3) 'Calcutta Corporation Water Supply : Chlorination of Unfiltered Water—a Possible Approach to Control Cholera Epidemic' by M. J. Shetty (*A.M.*) (*Journal*, vol. 41, no. 5, pt. 1, January 1961)

(4) 'Approximate Solution to Oxygen Sag Equation' by M. Y. Ansari (*Non-member*) (*Journal*, vol. 41, no. 11, pt.CI 1, July 1961)

(5) 'Some Concepts of Water Supply Engineering Design' by G. R. Kulkarni (*A.M.*) (*Journal*, vol. 42, no. 1, pt. CI 1, September 1961)

Roads and Road Transportation Group

Paper Meetings

(1) Introduction of the new Chairman, Shri H. P. Mathrani (*M.*) by Shri K. K. Nambiar (*M.*), retiring Chairman

(2) Address by Shri H. P. Mathrani

(3) 'Blending of Aggregates' by N. K. Vaswani (*A.M.*) (*Journal*, vol. 42, no. 1, pt. CI 1, September 1961)

Further details to be announced later.

Aeronautical Engineering Group

Paper Meetings

Details to be announced later.

February 7, 1962, 9.00 a.m. to 1.00 p.m.

Electrical Engineering Division

Paper Meetings

(1) 'Current Carrying Capacity of A.C.S.R. Conductors' by Prof. H. N. Ramachandra Rao (*M.*) and K. V. Vadiraj (*Non-member*) (*Journal*, vol. 41, no. 10, pt. EL 1, June 1961)

(2) 'Choice of D.C. Main Drives for Modern Rolling Mills' by N. C. Nayak (*A.M.*) (*Journal*, vol. 41, no. 12, pt. EL 2, August 1961)

(3) 'Negative Sequence Component of Current due to Unsymmetrical Loading of Three-Phase Power Systems' by T. V. Sreenivasan (*A.M.*) (*Journal*, vol. 41, no. 12, pt. EL 2, August 1961)

(4) 'Specific Features of 25 kV A.C. Electric Traction with Particular Reference to Ignitron Electric Locomotive' by B. V. S. Rao (*A.M.*) (*Journal*, vol. 42, no. 2, pt. EL 1, October 1961)

(5) 'Electric Traction' by P. N. Murti (*Non-member*) (*Journal*, vol. 42, no. 2, pt. EL 1, October 1961)

Mining and Metallurgy Division

Paper Meetings

Details to be announced later.

Chemical Enginering Division

(1) Symposium on 'Utilization of Industrial Wastes'

General Engineering Division

(1) Symposium on 'Anatomy of Slums'

Railway Engineering Group

Paper Meetings

(1) Address by Shri O. S. Murthy (*M.*), Chairman

(2) 'New Instrument for Tokenless Block Working' by T. C. Sarkar (*Non-member*) and S. S. Ghosh (*Non-member*) (*Journal*, vol. 41, no. 11, pt. CI 1, July 1961)

Further details to be announced later.

Industrial Management and Production Engineering Group

Paper Meetings

(1) Introduction of the new Chairman, Shri R. M. Patri (*M.*) by Prof. R. Natarajan (*M.*), retiring Chairman

(2) Address by Shri R. M. Patri

Details to be announced later.

Hindi Section

Paper Meetings

(1) Address by Shri Brijmohan Lal (*M.*), Adviser

(2) 'Problems in Villages—1. Housing Problem; 2. Sewage Disposal; and 3. Water Supply' by Vishwambhar Prasad (*A.M.*) (*Journal*, vol. 41, no. 1, pt. 1, October 1960; vol. 41. no. 6, pt. 1, February 1961; and vol. 41, no. 12, pt. HI 1, August 1961)

(3) 'Continuous Virendeel Girders' by B. N. Thadani (*A.M.*) (*Journal*, vol. 41, no. 9, pt. 1, May 1961)

(4) 'Protection of Single Wire Earth Return System' by R. K. Garg (*A.M.*) (*Journal*, vol. 41, no. 2, pt. 2, October 1960)

RAIL CONCESSION

The form for rail concession is attached at the end of this programme. Members attending the Convention and desirous of availing the concession are requested to fill in and return it in duplicate to the Secretary or the Honorary Secretary of their Local Centre.

In connection with rail concession, members will please remember that :

(1) The concession is available only for a to and fro journey by the shortest route between the railway station where the journey commences and Howrah/Sealdah.

(2) The concession is available only to the member's person, and cannot be extended to his lady or family.

(3) The Railway Board have authorized, as a special case, the Honorary Secretaries of the Local Centres, in addition to the Secretary of the Institution, to issue the certificate.

(4) The Railway Board require that a letter of authority should first be obtained from an authorized officer of the Railways who is generally the Chief or District or Divisional Commercial Superintendent, which should be produced to the Station Master of the railway station where the journey commences. *Members resident at small stations are particularly invited to note this as the Station Masters themselves are not authorized to admit the concession.*

(5) The Railway Board require that the Institution should submit a statement, after the Annual General Meeting, as to how many members availed themselves of the concession. **The continuance of the concession is dependent on the submission of this statement to the Board.** Members are, therefore, requested to (a) fill in the slip attached to the concession form and return it to the Headquarters after the Annual General Meeting, and also (b) to state if they availed of the concession in the special column which will be provided by the Bengal Centre in the Registration books at Calcutta. **These two requirements are most important.**

GRANT OF CASUAL LEAVE FOR GOVERNMENT OFFICERS ATTENDING MEETINGS OF SCIENTIFIC ASSOCIATIONS

An extract from notifications No. 74(4)/50-SR. III dated July 29, 1951, printed in the *Bulletin*, vol. 1, no. 1, September 1951, p. 28, and No. 27(7)/53-SR. III dated December 10, 1953, printed in the *Bulletin*, vol. 3, no. 3, March 1954, p. 14, issued by the Ministry of Natural Resources and Scientific Research, Government of India, in regard to the grant of casual leave to such officers as desire to attend meetings of scientific associations is reproduced below for information.

'..............subject to exigencies of Government business, Government servants who are invitees, members, official delegates of the organization concerned or have been asked to read papers at a conference may be given facilities to attend meetings organized by scientific associations like the Indian Science Congress Association, the National Institute of Sciences of India; the Institution of Engineers, the Indian Academy of Sciences, Bangalore, and other similar bodies, by the grant to them of special casual leave to the extent required for attendance at the meetings and for journeys to and from the place of meeting. It is requested that if there is no objection, requests from individual Government servants for leave to attend meetings of scientific associations may be disposed of in the light of this decision.'

THE INSTITUTION OF ENGINEERS (INDIA)
8 Gokhale Road, Calcutta 20

Subject: Rail concession to delegates attending the 42nd Annual General Meeting at Calcutta in February 1962

Railway Board Ref.: Appendix P/XXII-A [see Rule 118, Serial No. 18(1) & (2)]

Certificate Form

It is certified that Shri/Shrimati............................is a person travelling from................to Calcutta to attend the 42nd Annual General Meeting at Calcutta on February 1-8, 1961, and is entitled to the concession of return tickets in any class available for one month on payment of single fares, mail fares being charged for second and third classes.

(i) He/She is a servant of the Central/State Government/local body or a Statutory authority.

(ii) He/She is not a servant of the Central/State Government/local body or a Statutory authority.

(iii) His/Her travelling expenses will not be borne by the Central/State Government/local body or a Statutory authority.

Secretary/Honorary Secretary *Centre*

Place....................

Date....................

---

* I hereby certify that I am an employee of the Central/State Government/local body or a Statutory authority and that I shall not claim mileage allowance from the Central/State Government/local body or a Statutory authority for the journey performed on the concessional return ticket.

Signature..........................

Place.................... Designation.........................

Date.................... Office address.......................

....

Note: *1. This certificate must invariably be filled in by employees of Central/State Government/local body or Statutory authority.

2. Government servants, etc., whose travelling expenses are borne by the Central/State Government/local body or a Statutory authority either wholly or even partly are not entitled to this concession and it is his responsibility not to claim this concession. Any breach of this rule by the Government servant will render him liable to disciplinary action.

Keep this with you till after the Annual General Meeting, and then return it to the Headquarters.

I availed of the rail concession given by the Railway Board for members of the Institution attending its Annual General Meetings, and travelled on this concession from ....to Calcutta and back from Calcutta to.............. ....

Name of delegate ....

Signature..

Please tear off here and return to the Secretary/Honorary Secretary, Secretary, Bengal Centre

TESTING OF RIVETS AT BRIDGE GIRDER JOINTS ON RAILWAYS*

N. H. Subramani Iyer
Student

While the Indian Railways have shown a remarkable progress in the past few years, specially in the technical field, the engineers still cling to certain old methods, perhaps due to their reliability, even though these are tedious. For example, welding has almost superseded riveting in all requirements, yet the era of riveting of joints has not passed. Hence, it will be of interest to engineers to get an insight into the practice of the Indian Railways of keeping a periodical record of the tests for judging the merit of riveted joints.

The present day heavy WG and WP locomotives, with their increased axle loads, have an adverse effect on the wrought iron girders which were originally not designed to take these loads, though a high factor of safety was used. Consequently, there is a proposal to replace the 'below main line' (M.L.) standard girders by the new I.R.S. type girders. That the joints of these old girders are giving way is indicated by the results of testing of the rivets which is done on a programmed basis and the records are preserved.

The old practice of testing all the rivets in a joint is cumbersome, and this has been recently replaced by 'sample rivet testing'. This method is based on sampling and satistical probability. The basis of the formula for obtaining the probability is that a bulk of rivets contains not more than a chosen minimum percentage of defective pieces ; for this the results of a close inspection or test on a sample containing a limited number of pieces selected at random from the bulk must be known. The general formula is expressed as

$$P = \frac{\int_{x'}^{x''} x^{n-b}(1-x)^b \, dx}{\int_{0}^{1} x^{n-b}(1-x)^b \, dx}$$

where P is the probability expressed as a fraction, x the proportion of satisfactory pieces in the bulk, x'' and x' the limits of integration, n the total number of pieces selected at random from the bulk to form the sample, and b the number of unsatisfactory rivets detected in this sample.

These rivets must have been produced by a similar process and subject to similar conditions so as to be as nearly similar as possible.

Unit probability cannot be obtained from this equation except when the number of rivets in the sample is equal to the number of rivets in the bulk. It is suggested that the odds 1,000 to 1, *i.e.*, $P = 0.999$, may be accepted in practice.

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* The details given in this paper are based on the Indian Railways practice and no originality is claimed.

For deciding the lower limit for the proportion of satisfactory rivets, it may be said that a bridge structure containing about 40% loose rivets can still safely carry the traffic but requires that steps should be taken to replace the loose rivets as soon as possible. Hence, the lower limit may be taken as $x' = 0.6$. The upper limit will be 100%, *i.e.*, $x'' = 1$.

The number of rivets in the sample (n) is selected as 24 since it is divisible by 2, 3, 4, 6, 8 and 12, and thus can be equitably distributed over a number of joints or portions of a joint. The following development of the equation also shows that a sample containing not more than 24 pieces is adequate for the purpose. Substituting in the general formula,

$$0.99 = \frac{\int_{0}^{1} x^{24-b} - (1\ x)^{b}\, dx}{\int_{0.6}^{1} x^{24-b}\,(1-x)^{b}\, dx}$$

It will be seen that this equation is satisfied when $b = 3$. This may be interpreted as follows. If only 3 rivets are found unsatisfactory in a sample of 24, the chances are 1,000 to 1 that the bulk contains less than 60% good rivets. A second test is justifiable if the number of unsatisfactory rivets is more than 3, and further tests are likely to be necessary at frequent intervals.

It is, therefore, possible to divide all the rivets in all the girders of the same type in a given bridge into a relatively few categories or bulks.

The method of rivet testing is to tap the rivet with a standard hammer (¼ lb. in weight) keeping one finger on the rivet and another on the plate. But, to fix the category of the rivet requires experience and judgment. The rivets are classified as (i) sound, (ii) slightly loose, (iii) loose, (iv) very loose, and (v) hand loose. In bridges, where the depth of the girders is large, proper scaffoldings are essential for carrying out testing of intricate joints. Only after satisfying this condition, efforts should be made to start testing of the rivets. For triangulated spans, the categories of rivets used are many, and one 100 ft. span normally takes three to four hours for a satisfactory test. A few of the important categories of rivets are :

(i) Rivets connecting rail bearers to cross girders ;
(ii) Rivets connecting cross girders to post ;
(iii) Rivets connecting members of vertical bracing to gussets on main girder ;
(iv) Rivets connecting members of horizontal bracing to gussets ;
(v) Rivets connecting flange angles to web plate over-bearings ;
(vi) Rivets in web plate splice cover plates ; and
(vii) Rivets in flange plate splice cover plates.

Twenty-four rivets, suitably selected, are tested in each category. Despite this categorization, a good judgment is required to distinguish between some of these categories.

It is found in practice that the number of loose rivets in categories (i), (iii) and (v) are comparatively large, though there are bad rivets in other categories also. Various reasons can be attributed to the presence of such loose rivets. Bad workmanship is the foremost of these factors. Sufficient precautions should, therefore, be taken in any riveting work. A few of these precautions are listed below.

(i) The rivets should be of proper size, suitable for the thickness of the plate to be joined.

(ii) Rivets should be heated to reddish white, and while the riveting is being done, the temperature should not fall much.

(iii) Holes should be reamed wherever required.

(iv) Hammer and dolly should be kept in the correct position. There are certain corners where riveting is difficult, specially near the end boxes of the girders.

(v) The rivets should be tested and loose rivets should be cut and replaced.

Rivet testing is carried out on a programmed basis on the Indian Railways. The practice in the South-Eastern Railway is that not less than 20% of each type of spans of 40 ft. and over must be sample tested once in three years, *i.e.*, in a bridge of precisely five spans, any one particular span will be tested only after 15 years have elapsed. Plate spans below 40 ft. are generally not tested.

If the number of very loose and hand loose rivets is large, these should be cut and replaced. But it should be kept in mind that while so doing, there is possibility of adjacent rivets also getting sheared. Hence, if replacing of rivets is justifiable, the complete joint should be re-riveted to avoid further complications. If only a small number of rivets are loose, turned bolts can be used after cutting and removing these rivets. While riveting the joint completely, all the turned bolts should not be opened at a time. Only 50% of the turned bolts should be removed and the rivets substituted.

The strength of a bridge girder can be tested by many methods, such as by the stress test of each member, deflection test, cambre reading of the booms, etc. These tests help to assess approximately the strength of a girder and to gauge whether any regirdering is required or not. But, rivet testing is the most efficient way of studying the strength of a joint and a comparative study of the tests of several years will approximately give the statistical way in which the joints fail.

Rivet testing is one of the important routine works in bridge maintenance and has its own merits. It may become out of date when all the railway bridges are replaced by prestressed concrete, but that time is quite far off.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Bombay Centre

Chairman's address by Shri N. N. Purandare, B.E., M.Sc.(Eng.), D.I.C., F. ASCE, M.I.E., at the 39th Annual General Meeting of the Centre on August 25, 1961

The Chairman welcomed the Chief Guest, Nawab Mehdi Nawaz Jung Syed Mohamed Medhi, Governor of Gujarat, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1960-61.

During his address, Shri Purandare spoke on recent advances in large span structures in the following words: 'Modern architectural and engineering planning requires covering of large areas or long spans without intermediate supports, and hence the structural engineer is called upon to fulfil these requirements by designing structural members to suit such conditions. With large spans, the deadweight of the members plays an important part in design as the live load is insignificant compared to the dead load and the economy of design is governed by reduction in the weight of structural members. Here comes the ingenuity of the designer in creating different forms which would be light in weight without impairing the strength or the load carrying capacity of the member.

The study of the history of structural engineering and the various structures built by man from the primitive times to the present day will reveal that the engineer, with whatever knowledge at his command, was making structures stable and safe against the unstabilizing forces that he could conceive of. To him, the forces of nature were the unstabilizing forces and he used gravitational force to give the structures required stability. Naturally, massiveness and weight were the keynotes in his design and construction. A rapid survey will show the gradual change in the concepts of design.

From the days of the caves in rocks to the modern structure, man has been either imitating nature or getting his inspiration from it. The arch, flat-arch and beam, cantilever and catenary are some of the forms in nature that have been successfully exploited, but there still remain numerous other forms yet to be explained. In translating these forms into structures, mathematics plays an important part. The knowledge of the properties of matter and behaviour of materials under load makes the solution simpler. Slowly, with the advance in knowledge, the engineer started evolving forms akin to those found in nature. The modern structures are the outcome of work of many generations.

The stresses induced in the members of a structure due to load are bending stresses, direct stresses or a combination of both. For direct loads in pure tension or compression, the sectional area to withstand the stresses is provided, while to resist bending stresses, the member must have sufficient moment of inertia. Generally, a thin section is adequate for direct loads but, for bending stresses, the section should have such a form as to provide the required modulus.

Before I consider the different types of structures, I shall give examples from nature which have been successfully analyzed and copied.

One would feel that it must be dull and tiresome to find out structures in nature that could be imitated by engineers but it is a fascinating subject. John Ruskin created the book 'The Stones of Venice' by explaining structure and architecture in nature. Ruskin and Morris studied natural forms for their beauty of shape and colour, but the scientific study of living things, *i.e.*, biology, has shown innumerable examples where nature has evolved efficient structural forms. Whether the material for the structure is of a fibrous cellular character as in animals and plants, or of inert granular substance as in the egg shell, it is often used with maximum economy in relation to the forces the structure has to resist. This is possible only because continuity of structure is fully developed and because sectional forms, like corrugations, reduce deadweight.

Nature achieves spectacular results by using materials of fibrous cellular internal structure, immensely strong in relation to their weight. The outstanding example is the spider's web. In addition, the whole structural form (like the blade of grass, the lily leaf, and the walnut shell) is designed in section so that minimum materials are used to develop the maximum strength.

Conception is an imaginative, intutive process, usually implying long experience and a good sense of structures. The reduction in the deadweight of a structure involves two significant factors observed in nature. Engineers of imagination have shown that the distribution of material in structural members to resist stresses in the most efficient way may not only effect economy in material, but also in stronger structures. Thus, the knowledge of the behaviour of materials and structural elements and mathematics of structures is needed for assurance of stability.

I shall not refer to the theoretical part in the design of long span structures as any standard book treats the subject fairly well; but I shall refer to various shapes and forms. While applying the theory to these different forms the modern engineer relies on model analysis of the structure to assess the stresses at different points. It has become a routine practice to make scale models of the structures and interpret the test results to advantage in the design of members. This facility of model analysis is of utmost importance as any structural form not fitting in with the existing theoretical formulae, can be easily solved, and thus a rapid progress is maintained. Unfortunately, this much needed facility is not available with us to the requisite extent.

Structures involving spans can be divided into two categories :

1. Buildings of large span
2. Long span bridge

I shall refer mainly to buildings as form or shape play important part in the design.

Types of buildings requiring large spans are (i) auditoriums and covered sports arenas; (ii) aeroplane hangars; and (iii) industrial buildings with special requirements.

The present day requirements for (i) and (ii) are spans from 150 ft. to 400 ft. according to the purpose for which the enclosure is used and the size of aircraft to be housed. With such large spans, thin shell structures are the only answer if in concrete or frames-in-space both in steel and concrete. Shells with edge beams in prestressed concrete have made large spans a reality. Because of the high cost of centering for the barrel vault shells, shells as folded slabs and as hyperbolic or elliptical paraboloids are used for spans up to 75 ft. Ketchum in America used the folded slab shells of three and two elements to cover schools, gymasiums and factories, thus giving unobstructed view. He has designed over 20 structures using these types of shells.

The hyperbolic and elliptical paraboloids, though they show curvatures in both directions, can be considered as small elements of straight lines for centering purposes. The designs are simple and the economy effected in steel and concrete is appreciable. At Bedford in England, units of 48 ft. square were built recently, and have cost only 5 s. per sq. ft. of covered area. In Bombay, a canteen building for Killicks of the size 140 ft.×60 ft. of covered area was completed recently costing only Rs. 5.25 per sq. ft. for footing, column, and inverted *chatris* in reinforced concrete including waterproofing on top and downtake rain water pipe. This was an economical proposition.

Thus, it can be seen that membrane structures can be very economical to construct though they may need very complicated calculations and expert supervision.

Nervi and others covered large areas with frames-in-space, both in concrete and steel. The structural members used are so light that it is reported that the contractors were afraid to construct them. The members of such structures are working at full efficiency, and if there is a slight mistake during construction causing reversal of stresses, there would be a major catastrophe. Engineers of Bombay and Ahmedabad have seen the Calico Dome. It is Fuller's 'geodesic dome', theoretically adaptable for any span. Such types of structures with slight modifications have immense possibilities of use in structural engineering.'

Gujarat Centre

Chairman's address by Shri U. N. Mahida, B.E., M.I.E., I.S.E., at the 1st Annual General Meeting of the Centre on December 18, 1960

The Chairman welcomed the Chief Guest, Nawab Mehdi Nawaz Jung Syed Mohamed Mehdi, Governor of Gujarat, and thanked the Committee of the Centre for electing him Chairman for the year 1960-61.

During his address, Shri Mahida spoke on the establishment of a Developmental Research Institute for Gujarat in the following words, 'Though planning on a national scale in the wider interest of the country should be our principal goal, when linguistic units of administration have been finally accepted, regional planning has its justification. To facilitate, assist and influence such planning to achieve a balanced development of the resources of Gujarat, and particularly to ensure rapid industrialization, I have examined the need and possibility for the establishment of a Developmental Research Institute for Gujarat. The formation of a separate State of Gujarat has brought this problem to the forefront.

The future of Gujarat is inextricably associated with the efficient development of its natural resources and with the degree of industrialization reached in the near future. Engineers have a vital role to play in the industrialization of the State. It should be the duty of the newly established Gujarat Centre to take up the question of the establishment of this Institute and obtain such financial and other help as is necessary for its successful operation.

Aims and objects

I will now state briefly the aims and objects of this organization and its approach to different problems confronting the State. Broadly speaking, its approach should be to determine and suggest different measures for general economic development of the State. The problems will be, how to develop the resources in the widest sense of the word, and how to invest the limited supply of capital so as to ensure all round development in the least possible time and without causing any social disintegration or political disharmony. Such measures for economic development while ensuring a rise in income must also aim at large degree of employment.

The work of the Institute must be closely related to industrial planning of the type developed by technical experts and professional groups. The type of planning must be different from the now familiar programmes of public expenditure over successive five year periods or the setting up of production targets by the Government. This work may have a limited or a restricted aim, such as stepping up of both the agricultural and the industrial production, but this is the pressing need of the day. Planning, investigation, survey, and field and laboratory research undertaken by the Institute must culmimate in the drawing up of specific schemes of industrial production or projects for the development of natural resources. Such activities must not be limited to the physical possibilities of development of the resources but must constantly endeavour to weigh the chances of commercial exploitation. The investigation must furnish accurate, complete and reliable data for drawing up schemes of production, for the estimation of profits and the size of investments necessary.

To succeed in the task of rapid industrial development, certain basic requirements, generally referred to as 'economic overheads', must exist in sufficient measure. In the State, to diversify and to achieve a reasonable degree of 'scatter', the industries will have to rely amongst other things on sound agriculture. To provide this, rapid development of irrigation is necessary. Development of transport and communications is also important, but what affects industrialization most is the availability of power. The total absence of perennial irrigation and the lack of road communications in Gujarat are proverbial but the appalling shortage of power is virtually acting as a stranglehold on the development of industries. While it is realized that this Institute can directly do little in the actual provision of such facilities, it is necessary that it should devote considerable attention to the development of these economic overheads which serve as the foundation on which the structure of industry can be securely based. The Institute can help in this development by studying the requirements, deficiencies, possibilities of making good these deficiencies, and bringing them to the notice of the Government. In this phase of its activity, its work can be closely related to techno-economic surveys. It can create enlightened public opinion, formulate reasonable and practicable demands, and, by ensuring popular support, induce the Government to take suitable action.

The Institute should also publish the results of its investigations and popularize the concept of industrial planning both in the public and private sectors.

Working procedure

In the beginning, the Institute will have to devote considerable energy to the collection of data available at different sources, to bring together different interests and lines of investigation and consider them from the overall economic position of the. State. While considerable data and information are available, they are scattered over the State, and there are yawning gaps in the statistics. The Institute will, therefore, have to set up its own agencies for the collection of the missing data and for the conduct of further surveys and investigations to supplement the available information. Efforts will then have to be made to tabulate, classify and collate the information and present it in a form readily suitable for use in the investigation of different industrial schemes and developmental projects. In conducting this phase of the activities, it must be constantly borne in mind that to ensure integrated development of the different regions, the coordination of the closely related aspects of agriculture, industry, transportation, forests, minerals, public finance and Governmental organization is as important as the specialized investigations for the development of industries.

As economic progress depends to a very large extent on the adoption by the Government of appropriate development policy, legislative action and administrative measures, the activities of the Institute will have to be carried out, as far as possible, in coordination with similar activities of the Government through informal consultation, exchange of information and enlisting the help of the Government departments in the collection of data.

Almost all scientific and technical departments of the Government have a large variety of research projects and investigations. Not many of them find their way to the public or are used for developmental activities. It should be the endeavour of this Institute to keep track of such studies, analyze their findings, evaluate their results from a practical or commercial standpoint, and in suitable cases expand their scope to formulate financially sound schemes of development. It must be emphasized that while new data and information are needed in certain directions, bringing together, classification, coordination and systematic recording of the immense existing data are equally important. There is a lack of reliable statistics and other information necessary for realisitc planning, and the Institute will have to devote close attention to this requirement for a considerable time in the early stage of its activities.

In conducting the activities of the Institute, while it would be correct to offer co-operation to the Government agencies and act in coordination with the Government departments, it must be seen that the programmes and activities are widespread, and are planned more realistically, unfettered by interferences and delays.

While the Institute may not exclude fundamental research, its activities should mainly centre around applied research. To be of real use to the public, drawing up of definite schemes for regulated exploitation of natural resources and development of specific industries, with due regard to their financial feasibility and commercial possibility, should be undertaken. Such schemes should be carefully drawn up by experts and thoroughly scrutinized for financial soundness. They should then receive wide publicity so that people know their possibilities. Those schemes which cannot be handled or financed by the private sector should be brought to the notice of the Government with a view to their implementation in the public sector.

Agriculture is the main occupation of the majority of the people in Gujarat, and the development of land and water resources, experimental agronomical research, scientific crop planning and other measures for increasing the outturn per acre must engage attention. Both agriculture and industry should be properly coordinated, keeping in view that activities associated with industry are more important as a source of income than agriculture. With pronounced fragmentation of holdings, agriculture has been generally reduced to mere subsistence farming. For this reason, as also for the reason that agricultural and irrigation research can more appropriately be undertaken by the Government agencies, while problems of land development, land reclamation, agriculture and irrigation are not excluded from the objects of the Institute, emphasis will have to be laid on problems connected with the development, growth and distribution of industries.

The activities of the Institute should therefore be limited for the present, so far as land and water resources are concerned, to the study of the broad economic aspects of projects and their impact on industry and agriculture, and bringing to the notice of the Government possible projects not contemplated by them. It may study the need for research in this sphere, stress its importance in an appropriate manner, and induce the Government to take up such work.

The activities of the Institute may be grouped under different sections, each headed by an expert in the subject dealt with by the group and with a capacity and flair for research. He should be assisted by a competent panel of associates and a group of workers conversant with the problems to be tackled. The work may be generally honorary and part time so far as the senior leaders of the group are concerned, but the Institute may pay small honorarium and defray the expenses incurred in journeys made in the interest of the work and in making field investigations. The Institute may also employ experts and junior investigators for wholetime work and engage such staff as may be found necessary for secretarial and administrative work. It may also render financial assistance to individual workers or group of workers, institutions, societies, and others engaged in research calculated to promote the development of Gujarat, if such activities are not independently pursued by the Institute. Experimental and field research requiring the assistance of well equipped laboratories, research stations, models or laboratory scale pilot plants should be organized gradually when such facilities can be provided by the Institute. Till then, a scheme for conducting such work in coordination with the existing institutions, colleges, technical institutes, commercial laboratories and privately owned facilities may be worked out. Pending this arrangement, a beginning must be made, even though it may be in the nature of techno-economic surveys designed to examine, discover and assess the physical resources and the possibilities of their economic development. With such data, specific schemes of utilization of resources which promise commercial development should be worked out and the results published for general information. Further detailed work can then follow as equipment becomes available or this can be taken up by parties interested in the commercial development of the schemes suggested.

Financial requirements

There is no limit to the scope of research activities and correspondingly, there is no upper limit to the requirement of funds. But, it would be prudent to arrange for a capital expenditure of about Rs. 10 lakhs. For running of the Institute, a rough estimate is that a sum of Rs. 60,000 would be necessary annually, if its activities are to proceed systematically and continuously, and if proper men are to be attracted to this work.

To get the best out of the Institute, it will be necessary that those working for it, on the basis of wholetime employment or in honorary capacity, should continuously apply their talents to the work allotted to them with deligence and abiding interest. To ensure this, firstly, it should be put on a permanent footing with adequate financial resources. Then, with the fear of unemployment removed, the junior employees, investigators, statisticians and research workers can devote themselves wholeheartedly to their tasks. Secondly, the experts selected to guide the research personnel in their specialized activities and the Director to coordinate the activities and manage the Institution as a whole should be selected with great care and discernment to have only persons of the highest talents, willing and able to devote their time and energy to the work of the Institute. Such men should be actuated by missionary spirit and be attracted to the Institute by a spirit of service and not merely by the scale of emoluments. Also, the honorary workers selected to fill the highest positions or invited to direct the activities of the Institute should not accept these positions merely for the sake of prestige or recognition of their technical or scientific talents. They should be able to devote a definite portion of their time regularly to the duties entrusted to them.

An appeal

In concluding this appeal for the establishmental of Developmental Research Institute, I plead that the proposal should be proceeded with in the firm belief and confidence that we have in this region's natural resources, physical capacity, commercial acumen, and technical ability to produce much more than what we do at present ; and it is our productive capacity alone which fixes the limit beyond which our standard of life cannot go. Another view point to be constantly borne in mind is that organized regionwise research, and not isolated individual efforts, is the real necessity of the present time. The people of Gujarat must realize that if contribution of research is absent the industries in the State will tend to freeze, that scientific and developmental research is an important public function entitled to liberal and systematic support, and that either they industrialize or perish.'

Kerala Centre

Chairman's address by Shri C. S. Padmanabha Aiyar, B.A., D.C.E., B.E., M.I.E., at the 14th Annual General Meeting of the Centre on January 2, 1961

The Chairman welcomed the Chief Guest, Shri V. V. Giri, Governor of Kerala, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1960-61.

Delivering his address, Shri Padmanabha Aiyar said, 'Engineering is a progressive science and as the boundaries of knowledge get enlarged, more branches or fields of specialization get opened up. There is, however, considerable interdependence among these branches. The Institution represents all the branches of engineering, such as civil, mechanical, electrical, electronics and telecommunications, chemical and metallurgical. These branches were till recently functioning under different technical groups. Recently, changes were made whereby considerable autonomy has been afforded to these branches. It is hoped that these changes will set at rest the fissiparous tendencies sometimes displayed suggesting the opening up of separate insitutions for the different branches. In this context, it is interesting to note that in countries like the U.S.A., where there are separate institutions and societies for different branches of engineering, the demand for a common institution is gathering momentum.

We are on the threshold of the Third Five Year Plan and it may not be out of place to make a brief reference to the part that engineers have to play in its implementation. The Third Plan for Kerala envisages an outlay of Rs. 170 crores in the public sector, excluding the centrally sponsored and central sector schemes. Out of this, nearly Rs. 82 crores are directly concerned with engineering projects under power, irrigation, flood control, roads and bridges, water supply, etc. In addition, buildings and other structures costing about Rs. 12 crores may be required under other sectors of development, such as eduction, health, housing and industries. Thus, nearly Rs. 94 crores will have to be translated into various types of works by the engineers in the State during the Third Plan period. A very heavy responsibility for the development of the State has, therefore, to be shouldered by engineers.

By far the most important sectors of development are the production and distribution of power and expansion of irrigation. Having been connected for some time with works in these fields, I shall take this opportunity to highlight some of the important features of development proposed in these branches.

Power supply in the State is confined to hydro-electric schemes. So far, only three schemes have been completed with a combined installed capacity of 117.5 MW. A scheme in the Muthirapuzha valley, the Neriamangalam scheme (45 MW), is about to be completed, and the Penniyar (30 MW) and Sholayar (54 MW) schemes are under execution. The total capacity when these schemes are commissioned will be 246.5 MW, which is only about 12% of the estimated available potential in the State.

The Pamba-Kakki project (300 MW), work on which has recently been started, will be the biggest hydro-electric project in the State. It envisages the utilization of regulated discharge from the Pamba and Kakki catchments (830 cusec.) over a fall of nearly 2,400 ft. into a tributory of the Pamba River. The project involves construction of two major dams, one 165 ft. and the other 360 ft. high, about 5½ miles of tunnels, six penstocks, six generating sets of 50 MW each, 2 × 100 miles of 220 kV transmission lines, and various ancillary works such as roads, buildings, bridges, etc. The Kakki Dam under this project will be the second highest dam in south India and the third highest in India.

Other schemes which are to be taken up for power development during the Third Plan are the Iddiki and the Kuttiadi schemes. The Idikki scheme on the Periyar River will involve two major dams and about six miles of tunnels to divert the Periyar water to a fall of about 2,200 ft. into the Thodupuzha River near Ernakulam. It will have an installed capacity of 420 MW.

The Kuttiadi scheme involves an installed capacity of 24 MW. Although small, the scheme presents several design and constructional problems in regard to the dam.

It is sometimes believed that Kerala, with its abundant rainfall, does not need irrigation. The notion is entirely fallacious. Although there is heavy rainfall, but it is confined only to few months in a year, and acute drought conditions prevail in several areas during summer months. The soil, which is latritic, is generally porous and does not retain enough moisture to sustain growth of crops like paddy. Irrigation is therefor necessary and has been practised from ancient times through small diversion works and storage tanks. The rugged terrain of the State makes it difficult for major irrigation schemes to be taken up. However, with the difficulty of importing foodgrains, the need for an all-out effort in providing irrigation to more areas became urgent. There are seven major schemes under operation, the Malampuzha, the Walayar, the Peechi, the Vazhani, the Chalakudy, the Mangalam and the Gayathupuzha. Four more schemes, the Neyyar, the Pothundy, the Cheerakuzhy and the Periyar valley schemes are under execution and are expected to be completed early in the Third Plan. When these are completed, the total irrigated area will be about 292,000 acres, *i.e.*, 23% of the total area of paddy fields in the State.

The new schemes under major irrigation to be taken up in the Third Plan are : (i) the Kallada scheme with a storage reservoir and two main canals, irrigating a total area of about 109,000 acres, (ii) the Valapatanam diversion scheme, irrigating 40,000 acres, (iii) the Pamba scheme, irrigating 33,000 acres, (iv) the Kuttiadi scheme, irrigating 35,000 acres, (v) the Chitturpuzha scheme, stabilizing the precarious supply in the Chittur area and extending irrigation to an area of 25,000 acres, and (vi) the Kanjirapuzha scheme storage reservoir and supply canals to irrigate 24,000 acres.

In addition, a start will also be made for constructing canals below the proposed power house in the Iddiki scheme, so that when the scheme comes into operation, the canals will be ready to utilize the water for irrigating an area of nearly 115,000 acres in the Ernakulam and Kottayam Districts.

Judging from past experiences, the main obstacles in the way of speedy progress are: (i) lack of planning and investigation, requiring changes as the projects progress, (ii) administrative difficulties due to overcentralization and adherence to outmoded rules and regulations, (iii) delays in procurement of plant and machinery, especially where foreign exchange is involved, and (iv) delays in land acquisition.

To overcome these difficulties, the following suggestions are made.

(i) Schemes should be investigated sufficiently in advance. Very often, due to pressure of public opinion, the engineers are called upon to start schemes even before the investigation is completed.

(ii) Although we often hear proposals for decentralization and for simplifying administrative procedures, the decentralization is never effective.

(iii) Normally, about two years elapsed before plant and equipment can be procured from abroad. A considerable amount of forward planning and sustained action thereafter is necessary.

(iv) The present Land Acquisition Act and the procedures prescribed therein are so cumbersome that considerable delays can occur before the required lands are made available for the work.

What I have stated above refers to administrative bottlenecks. Even when these are removed, progress and efficiency can be achieved only through unstinted hard work put forth by engineers. As stated earlier, engineering is a progressive science and many remarkable developments have taken place in regard to the use of new materials, design techniques and construction methods. Unless we keep abreast of times and profit by the knowledge and experience gained by engineers in different parts of the world, we will soon become unfit to fulfil the expectations of a civilized society.

In this context, the Institution plays a very useful part. It makes available a suitable forum for discussion on matters of technical interest so that the experience of one can help to solve the difficulty of another. It also maintains a library of technical books and periodicals.

We have a heavy task ahead of us. Let us work together and justify our position by enthusiatic work for the welfare of the nation.'

Summaries of Paper Published in the Journal vol. 42, no. 3, pts. Cl. 2, ME 2, and MM 1, November 1961

CIVIL ENGINEERING DIVISION

Soil Studies for Design of Foundations of a Sluice

B. Maitra
Member
and
H. L. Saha
Non-member

A sluice being a hydraulic structure should be safe against functional as well as structural failure. In order to prevent such failure, the design of the structure is considered in two parts, comprising (i) hydraulic calculations, and (ii) structural calculations. Both these elements of design depend to a certain degree on the data of the subsoil conditions at a particular site. It is, therefore, essential that accurate appraisal of the foundation condition is made at the initial stage and the data are considered in the design of the sluice. This paper highlights the soil studies needed for the design of the foundation of a sluice. An attempt is also made to account the effect of such studies on the design and construction aspects.

Edge Disturbance in Circular Cylindrical Shells

S. K. Mallick
Non-member

The analysis of shells forms a major problem in engineering design. Considerable work has been done during the last 30 years to present the theory in a compact and simplified form for ready application to design problems. These developments have been reviewed by McNamee and Jenssen and are well known.

In this paper, Holand's new approach to the computation of edge disturbances is briefly presented and illustrated by an example. Finally, the solutions are compared with those obtained by another method.

The preliminary stages, *i.e.*, expressing the forces, moments, displacements, etc., in terms of a single variable are elementary and not given here. The differential equation as it follows from Flugge's equations is stated, and the various stages thereafter for computing the edge disturbances are presented in detail. The scope of this paper is limited to disturbances from the straight edges only.

The Kosi—a Challenge in River Control

D. Mookerjea
Member

The River Kosi has been one of the problem rivers in the world. It is subject to sudden spates, sometimes rising 30 ft. in 24 hr. within the gorge. The problem of flood control in the Kosi was given serious attention only in 1946 when it was proposed to put up a storage dam, but the idea had to be given up as the site of the dam lay within an active seismic zone of uncertain geological conditions. The idea of channel improvement works and construction of levees gained prominence after the flood havoc of 1953. The practical difficulties that had to be overcome in the construction of levees, the Kosi Barrage, and the canal system have been dealt with in this paper. The work in the embankment and its maintenance, the rehabilitation of people in the embanked area, and the setting up of the hydro-electric power house on the main canal are the other problems discussed. The benefits that have resulted from the project are mentioned.

Combined Power House and Spillway Sluice

Y. K. Murthy

Member

It is a novel feature to provide spillway outlet sluices in the substructure of a power house in addition to the conventional spillway, if the foundation is not sound rock and the intensity of discharge to be handled does not exceed 60 to 65 $m.^3$ per sec. per m. length. Experiments have shown that this results in an increase in power output of 1 to 2%. The author has discussed different arrangements for spillway outlet sluices. The importance of downstream protection in the case of discharging over non-rocky foundation is stressed. Recently, this arrangement in a modified form has been adopted in the design of East Kosi Canal power house to develop nearly 20 MW by utilizing the minimum discharge of 7,500 cusec. and a head of about 20 ft. This system of spillway sluice is much used in the U.S.S.R. and will be particularly useful in India where a number of power houses are proposed in the plans.

MECHANICAL ENGINEERING DIVISION

Rigidity of Recirculating Ball Screw

S. K. Basu

Associate Member

Recirculating ball screw assemblies are extensively used in programme-controlled machine tools. The paper presents a comparison between a conventional sliding screw assembly and a recirculating screw assembly, and analyzes mathematically the influence of the tolerance of ball size and that of the error in the helix angle of the threads on the rigidity of the assembly.

Mechanics of Chip Formation of Controlled Contact Cutting Tools

A. Bhattacharyya

Associate Member

and

R. K. Ghosh

Non-member

It is recognized that controlled contact cutting tools are much superior in performance as compared with conventional tools. The significance of a new machining variable, *i.e.*, the tool-chip contact length, has been pointed out in the analysis of tool-chip friction and interface temperature. A number of investigations were undertaken which clearly demonstrated that properly restricted contact length reduces interface temperature, decreases friction, and improves tool life. In this paper, an attempt is made, based on experimental results, to explain chip formation of controlled contact tools by investigating the interfacial stress distribution and plasticity conditions.

Variable Frequency Torsional Vibration Generator

A. S. Kenkare

Non-member

A vibration generator can be hydraulic, pneumatic, electromagnetic or electrodynamic. The paper describes the design and construction of a variable frequency torsional vibration generator constructed for a study of the effect of torsional vibration on lubrication. It can also be used for finding the natural frequency of torsional vibration and the frequency response of a torsional elastic system. A brief description of the methods of measuring superimposed vibrations is included.

MINING AND METALLURGY DIVISION

Metals and Alloys for High Temperature Service

Dr. S. Bhattacharyya

Associate Member

The requirements of metals and alloys for high temperature service are discussed in this paper. The density and melting point of aluminium, magnesium, titanium, iron, tungsten, beryllium, etc., and the rupture strength of stainless steels are given to find their suitability for different applications. The developments in the application of non-metals and intermetallics, and ceramics and 'cerametS' are briefly discussed. In conclusion, based on conceivability, feasibility and desirability, the future prospects and technology of metals and alloys for high temperature service are outlined.

Controlled Swivel for Wire Ropes on Deep Winds

A. Seetharam

Member

The difficulties encountered in the installation of Gifford's shaft ropes led to intensive studies on seven pairs of ropes under different torques and types of swivelling. It was observed that the pair of ropes on which controlled swivel was used gave the best performance in service and the shaft h.p. developed. The last pair of ropes on which controlled swivel was used and the spin released at the bottom of the shaft has been the ideal expected and achieved so far. Better results are achieved by removing quite a number of twists on these ropes.

INSTITUTION NOTICES

Distribution of Institution publications

In the recent months, with the increasing Roll and requirements of the membership, the scope and volume of work to be handled by the Headquarters has become as diverse as exacting, particularly in the addressograph unit of the Membership Department. Continuous work-handling of the addressograph machine to cope with the day-to-day demands has resulted in a system breakdown which has been anything other than easy to set right despite the best efforts that are being made. In the background of the rigid restrictions of foreign exchange, the Government has refused even to grant a licence for the import of spares and address plates for the addressograph machine, let alone a spare machine. The unit has to emboss and print not very much less than 100,000 names and addresses each month, and the machine failure and non-availability of plates and spares has led to such disruption that some members have complained about incorrect distribution of the Instituion publications each month, the sectional distribution of which has added further complications. Members are requested to bear with this circumstance which has been quite beyond our control. It is hoped that the many alternative arrangements now being examined will ease the situation soon.

Symposia to be held during the 42nd Annual Convention, Calcutta, February 1-8, 1962

The Council have decided to hold Symposia in each Division during the Paper Meetings at the 42nd Annual Convention at Calcutta, February 1-8, 1962. The following subjects have been selected as subjects for the symposia.

1.	Civil Engineering Division	Role of Reservoirs in the Solution of Flood Problems
2.	Mechanical Engineering Division	Machine Tools and Metal Cutting
3.	Electrical Engineering Division	Power Supply in India
4.	Mining and Metallurgy Division	(i) Mine Mechanization
		(ii) Development of Non-Ferrous Metals and Alloys During the Third Five Year Plan
5.	Electronics and Telecommunication Engineering Division	Transistors and Semi-conductors in Communication and Electronics
6.	Chemical Engineering Division	Utilization of Industrial Wastes
7.	General Engineering Division	Anatomy of Slums

Papers are invited for submission at the Symposia so as to reach the Honorary Secretary, Bengal Centre, 8 Gokhale Road, Calcutta 20, on or before December 31, 1961.

New scheme of examinations in Sections A and B of the Associate Membership Examination

The Council have decided to introduce a new scheme of examinations in Sections A and B from November 1962. The scheme has been in preparation for some years, the primary object being to divide the Associate Membership Examination in Sections A and B into the following branches: Civil Engineering; Mechanical Engineering; Electrical Engineering; Chemical Engineering; Metallurgical Engineering; Mining Engineering; and Electronics and Telecommunication Engineering.

The need was increasingly felt that the examinations should be conducted in these branches separately instead of as in the present scheme which does not specify the branch of engineering in which candidates pass out. This latter has created some difficulties as employers often desire definite certification by the Institution that the candidate has passed in one or the other branch of engineering. The new scheme will, therefore, assist successful candidates in employment. Additionally, the new scheme also brings the contents of the syllabuses up-to-date.

The detailed syllabuses will be available in the booklet 'Rules and Syllabuses', which will be available in March 1962.

The procedure for the introduction of the new scheme is also explained below, and Students of the Institution are particularly asked to study it very carefully.

Candidates intending to appear in **Section A** examination will be required to take the following eight subjects:

	Subject	Marks
1.	Mathematics I	.. 100
2.	Mathematics II	.. 100
3.	Applied Mechanics	.. 100
4.	Principles and Applications of Electricity	.. 100
5.	Heat, Light and Sound	.. 100
6.	Engineering Drawing	.. 100
7.	Strength of Materials	.. 100
8.	Elementary Surveying	.. 100

Candidates intending to appear in **Section B** examination will be required to select any one of the following seven branches of engineering. Candidates will have to appear in nine subjects—seven compulsory and two optional.

1. Civil Engineering

(a) *Compulsory*

1. Materials and Construction
2. Theory and Design of Structures
3. Structural Engineering

4. Surveying and Geodesy
5. Hydraulics
6. Design and Drawing (5½ hrs.)
7. Elementary Geology

(b) *Optional* (*any two*)

8. Irrigation Engineering
9. Architecture
10. Soil Mechanics and Foundation Engineering
11. Railways
12. Agricultural Engineering
13. Public Health Engineering
14. Town Planning
15. Highway Engineering
16. Harbours and Docks
17. Thermodynamics and Heat Engines
18. Water Power Engineering
19. Production Technology and Industrial Engineering
20. Industrial Administration

2. Mechanical Engineering

(a) *Compulsory*

1. Engineering Materials
2. Thermodynamics and Heat Engines
3. Industrial Organization and Management
4. Workshop Technology
5. Design and Drawing (5½ hrs.)
6. Hydraulics and Hydraulic Machinery
7. Theory of Machines

(b) *Optional* (*any two*)

8. Production Technology
9. Thermal Power Engineering
10. Industrial Engineering
11. Refrigeration
12. Air-Conditioning
13. Water Power Engineering
14. Aerodynamics
15. Railway Locomotives and Rolling Stock
16. Automobile Engineering
17. Agricultural Engineering
18. Railways

19. Utilization of Electric Power
20. Metallurgy of Iron and Steel

3. Electrical Engineering

(a) *Compulsory*

1. Engineering Materials
2. General Mechanical Engineering
3. Electrical Measurements
4. Theory and Performance of Electric Machines
5. Generation, Transmission and Distribution of Electric Power
6. Design and Drawing (5½ hrs.)
7. Industrial Administration

(b) *Optional (any two)*

8. Utilization of Electric Power
9. Production Technology and Industrial Engineering
10. Electric Traction
11. Illumination Engineering
12. Line Communication
13. Radio Communication
14. Water Power Engineering
15. General Electronics
16. High Frequency Currents
17. Agricultural Engineering
18. Thermodynamics and Heat Engines
19. Thermal Power Engineering
20. Principles of Line and Radio Communications

4. Chemical Engineering

(a) *Compulsory*

1. Industrial Stoichiometry and Mechanics of Fluids
2. Size Reduction, Mixing and Separation
3. Principles of Heat Transmission and Furnaces
4. Diffusional Processes, Evaporation and Distillation
5. Fuels and Combustion
6. Design and Drawing (5½ hrs.)
7. Engineering Materials

(b) *Optional (any two)*

8. Elementary Electrical Engineering
9. Thermodynamics and Heat Engines
10. Gas Engineering
11. Materials and Mechanical Construction of Chemical Plants

12. Metallurgy
13. Refrigeration and Air-Conditioning
14. Chemical Works, Organization and Management
15. Geology
16. Thermal Power Engineering
17. General Mechanical Engineering
18. Metallurgy of Iron and Steel
19. Heat Treatment of Metals and Alloys

5. Metallurgical Engineering

(a) *Compulsory*

1. Metallurgy of Iron and Steel
2. Non-Ferrous Metallurgy
3. Mineral Dressing
4. Physical Metallurgy and Physical and Mechanical Testing of Metals
5. Refractories
6. Foundry Engineering
7. Heat Treatment of Metals and Alloys

(b) *Optional (any two)*

8. Metallurgical Analysis
9. Industrial Metallurgy
10. Physics of Metals
11. Metallurgy of Less Common Metals
12. Metallurgical Thermodynamics
13. Engineering Metallurgy
14. Electro-Metallurgy and Hydro-Metallurgy
15. Fuels and Furnaces
16. Workshop Technology
17. General Mechanical Engineering
18. Thermodynamics and Heat Engines
19. Principles of Heat Transmission and Furnace
20. Size Reduction, Mining and Separation

6. Mining Engineering

(a) *Compulsory*

1. Principles and Practice of Coal Mining
2. Principles and Practice of Metal Mining
3. Mine Ventilation, Explosions, Fires and Inundation
4. Mine Surveying
5. Mineral Dressing
6. Mining Geology
7. Mining Machinery

(b) *Optional (any two)*

8. Generation, Distribution and Utilization of Power in Mines
9. Mine Design and Planning
10. Mine Organization and Management
11. Mine Economics
12. Metallurgy and Assaying
13. Fuels and Refractories
14. Drilling Engineering
15. General Mechanical Engineering
16. Size Reduction, Mixing and Separation
17. Metallurgy of Iron and Steel
18. Non-Ferrous Metallurgy

7. Electronics and Telecommunication Engineering

(a) *Compulsory*

1. Engineering Materials
2. General Electrical Engineering
3. Principles of Line and Radio Communications
4. Applied Electronics and Circuits
5. Transmission Lines and Networks
6. Design and Drawing (5½ hr.)
7. Advanced Radio and Electronic Engineering

(b) *Optional (any two)*

8. Antenna and Wave Propagation
9. Radio Communication Systems
10. Audio Frequency Engineering
11. Electronic Measurements
12. Industrial Electronics
13. Radar Engineering and Microwave Techniques
14. Television
15. Telegraphy and Telephony
16. Carrier Current Engineering
17. Principles of Semi-Conductors and Transistor Circuits
18. Servomechanisms
19. General Mechanical Engineering
20. Production Technology
21. Electrical Measurements
22. Industrial Administration

The minimum marks for exemption from future examination in any subject are 50.

The pass marks in any subject are 35. But, if the overall (final) result is 'Failed', exemptions from future examinations will not be granted unless the marks are 50 or above in the subject or subjects concerned.

The papers of Section A (eight in number) may be taken by the examinees one or more at a time, but an aggregate of 400 marks for the whole Section of examination and not less than 35 marks in each paper shall have to be secured for a final pass in the Section.

The papers of Section B (nine in number) may be taken by the examinees one or more at a time, but an aggregate of 450 marks for the whole Section of the examination and not less than 35 marks in each paper shall have to be secured for a final pass in the Section.

Procedure for introduction of the new scheme

1. The first examinations in accordance with the new scheme will be held in November 1962.
2. Candidates intending to appear for Section A or B examination for the first time in November 1962 or thereafter will have to appear in accordance with the new scheme.
3. Candidates who have not secured any exemption from any paper of Section A or B prior to the November 1962 examination will also be required to appear for the respective Sections in November 1962 or thereafter in accordance with the new scheme.
4. The last examination under the presently existing scheme will be held in November 1963 for the benefit of those who have secured one or more exemptions under it.
5. The examinations in Sections A and B will be held simultaneously under the present and the new schemes in November 1962, May 1963 and November 1963.

6.(a) Candidates who fail to pass the Section A or B examination completely by November 1963 in accordance with the present scheme will have to appear in the respective Sections in May 1964 in accordance with the new scheme to be introduced in November 1962.

(b) Candidates under this category will not, however, get the benefit of exemptions previously obtained under the present scheme.

Rules for Students appearing in Section B of the Associate Membership Examination

Attention of Students intending to appear in Section B of the Associate Membership Examinations is drawn to the provision of Rule 11.2.4 which has been amended and now reads as follows :

11.2.4 — He shall then periodically appear before the Referee as mentioned under 11.2.2 and present to him full details of his engagement in the profession and supply him such further information as the Referee may require. The number of such interviews shall be three in the total period of twelve months, each interview covering a period of **four** months. He will have to express in writing the subjects of his choice under Section B even at the time of the first interview.

Use of handbooks for 'Engineering Drawing II' paper of Section B of Associate Membership Examination

Attention of Students is drawn to the fact that, in future, no handbooks will be allowed to be used by candidates appearing in 'Engineering Drawing II' paper of Section B of the Associate Membership Examination.

Steel Tables giving properties of steel sections (of the Dorman Long type) and Mathematical Tables, may however be used by candidates.

Prizes to commemorate the inauguration of the 40th Annual General Meeting in New Delhi by the Prime Minister of India

Attention of members is drawn to the notice in the *Bulletin* dated August 1961 with regard to the submission of essays on selected topics for the award of prizes to commemorate the inauguration of the 40th Annual General Meeting in New Delhi by the Prime Minister of India.

Since the response has not been encouraging, the time for receiving the essays has now been extended up to December 30, 1961. The manuscripts should reach the Headquarters on or before this date.

Retired engineers

In various discussions, it has been suggested that the services of retired engineers are not being profitably used in our expanding economy. With a view to collect information on the engineers who have retired from service, this notice is inserted to request engineers who have retired from service during the past few years and who are physically fit to give a brief account of the positions held immediately prior to retirement, with their present age and address. Letters may please be addressed to the Technical Officer (Scientific) at the Institution Headquarters address.

INSTITUTION NEWS

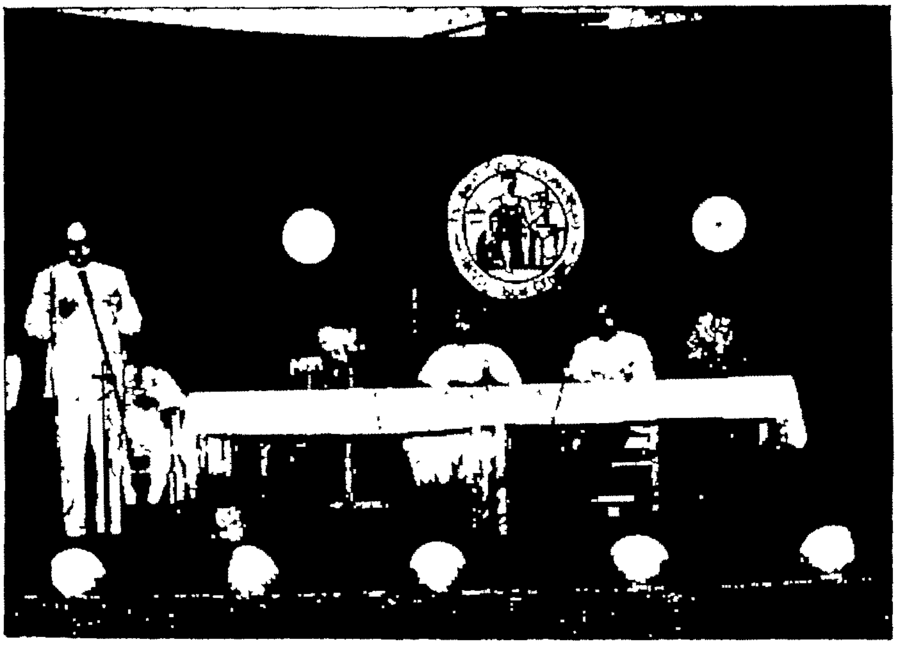
Opening of a new Sub-Centre at Ranchi

As approved by the Council in their 418th Meeting held in Bombay on February 6, 1961, a Sub-Centre of the Institution was opened at Ranchi, Bihar. Shri M. N. Das (*M.*) and Shri V. K. Ambast (*A.M.*) were elected Chairman and Honorary Secretary, respectively. The Sub-Centre was inaugurated by Shri Bhola Nath Paswan, Minister for Excise, Forest, Welfare Bihar, on July 23, 1961

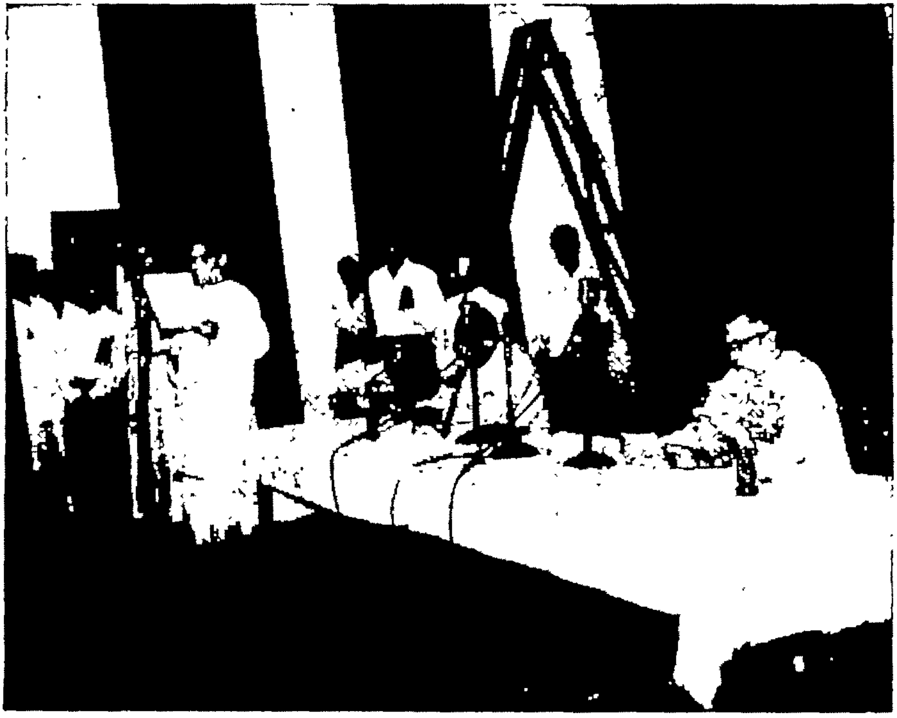
Shri P. R. Guha (*M.*), Chairman, Bihar Centre, welcomed the Chief Guest and other invitees. Delivering the welcome address, Shri Guha traced the history and development of the Institution since its inception. He also described the administrative setup and the activities of the Institution. Shri M. N. Das then spoke as the Chairman of the Sub-Centre. This was followed by a short inaugural address by Shri Paswan in which he emphasized the importance of engineers for the development of the country and stressed the need for expanding technical education.

He then declared the Sub-Centre open.

SHRI P. R. GUHA, CHAIRMAN, BIHAR CENTRE WELCOMING THE GUESTS AND MEMBERS



SHRI M. N. DAS, CHAIRMAN, RANCHI SUB-CENTRE, ADDRESSING THE GATHERING



SHRI BHOLA NATH PASWAN, CHIEF GUEST, DELIVERING THE INAUGURAL ADDRESS

The inaugural function was followed by a symposium during which a number of technical papers were read and discussed.

The Chief Guest, members and other invitees were entertained at dinner at the Ranchi Club on July 23, 1961. A lunch was also arranged at the Grand Hotel, Ranchi, by the courtesy of Patel Engineering Co.

BOOK ACKNOWLEDGMENTS

1. **Hydraulics.** Dr. Jagdish Lal. *Metropolitan Book Co. (P), Ltd.*, Delhi, Rs. 10. 3rd edition. 450 pages.

This book is intended to serve as a text and reference book on hydraulics, and covers the syllabus in hydraulics as prescribed in engineering colleges and universities in India. Chapters on (i) viscous flow, including boundary layer, (ii) compressible flow, (iii) applications of compressible flow, and (iv) fluid mechanics have been added in this third edition, with a view to bring it in conformity with the trend of replacing the course in 'hydraulics' by one in 'fluid mechanics'. The metric system has been incorporated in this edition.

2. **The Fundamental Principles of Hydraulics, Vols. 1 and 2.** V. B. Priyani. *Charotar Book Stall*, Anand, Rs. 12.50. 2nd edition. 352 pages.

This second edition of a book dealing with basic principles of hydraulics is an enlarged and revised version of the first edition, and includes additional numerical problems.

3. **Hydraulic Machines.** Dr. Jagdish Lal. *Metropolitan Book Co. (P), Ltd.*, Delhi, Rs. 18.50. 3rd edition. 601 pages.

This third edition of a book intended to cater for the needs of students preparing for an engineering degree course or equivalent examination and dealing with the principles of hydraulic machines and their design, has been revised and enlarged to include information on safety devices for penstocks, details of Deriaz turbine runner, tidal power projects, boundary layer theory, design of valves for reciprocating pumps, procedure for testing of turbine and pump, and hydraulic cranes and lifts.

4. **Engineering Materials, Part 2.** N. K. R. Murthy. *Youngman & Co.*, Madurai, Rs. 6.50. 507 pages.

This second part of a book intended to cater for the needs of students preparing for degree or diploma examinations in engineering or architecture in the subject of engineering materials, covers properties, preparation and uses of timber, metals, paints, varnishes, distempers, asbestos, and other building materials, in the form of questions and answers.

5. **Geometrical Drawing, Part 2.** S. K. Basu and A. K. Ray. *S. K. Lahiri & Co. (P), Ltd.*, Calcutta, Rs. 4.00. 9th edition. 218 pages.

This second part of the ninth edition of a book dealing with principles of geometrical drawing covers projections, sections, development of surfaces, isometric projections, descriptive geometry, interpenetration of solids, and shadows and shades.

6. Design of Welded Structural Connections. O. W. Blodgett and J. B. Scalzi. Published by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, $1.00. 92 pages.

This manual on design of welded structural connections is intended to cater for the needs of engineering students, practising structural engineers and architects. It covers the principles of the arc welding process, weldability of structural steels, distortion, design of connections used in buildings and bridges by elastic and plastic theories, and inspection of welded structures.

7. A Text-Book of Practical Geometry or Geometrical Drawing. V. Lakshminarayanan and R. S. Vaishwanar. *Jain Brothers*, Pilani, Rs. 12.50. 407 pages.

This book covers the syllabus in the subject of geometrical drawing, and includes projections of points, lines and solids, conic sections, isometric projection, sections of solids, and development and intersection of surfaces.

PUBLICATIONS RECEIVED

A publication entitled 'Proceedings of the Symposium on Vibration Testing of Roads and Runways' has been received from the Koninklijke/Shell-Laboratorium, Amsterdam. It includes the papers read at the Symposium on 'Vibration Testing of Roads and Runways', held at the Koninklijke/Shell-Laboratorium, Amsterdam, from April 20-24, 1959.

A booklet entitled 'How to Read Shop Drawing' has been recently received from the Lincoln Electric Co., Cleveland, Ohio. It deals with the common practices in reading shop drawings, with special reference to welding and welding symbols as standardized by the American Welding Society.

LIST OF NEW ELECTIONS AND TRANSFERS

(Continued from the Bulletin for October 1961)

MEMBERS

No.	Name	No.	Name
2426	Chandidas Mitra	2436	Jivaraj Valchand Shah*
2427	Madhukar Govind Bhat	2437	Richard Jakob Josef Pfenniger
2428	Benarsi Lal Singh*	2438	Wishwanath Prabhakar Karnik*
2429	Lt.-Col. Kartar Singh	2439	Benoy Bhusan Das Gupta*
2430	Chandra Prakash	2440	Dhanvada Hari Ramchandra Rao*
2431	Govindram Khanchand Chandiramani*	2441	Kamal Kumar Mitra*
2432	Ramesh Chandra Bose*	2442	Fulchand Manilal Patwa
2433	Dr. Santosh Kumar Mukhopadhyay*	2443	Maj. Laxman Rai Baronia*
2434	Jai Deo Sahai*	2444	Sanat Kumar Majumder*
2435	Gobichettipalayam Venkatramanaiyer Subba Rao	2445	Tribeni Nath Das
		2446	Subramaniaiyer Swayambu

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* Transferred from Associate Member

MEMBERS (*contd.*)

No.	Name	No.	Name
2447	Prabhu Dyal Kavan	2463	Manohar Yadaorao Koli*
2448	Kailash Chandra Mathur*	2464	Ramanathpur Tippaiya Vasantha*
2449	Subhransu Sekhar Mazumdar*	2465	Gopal Mahadev Marathe*
2450	Anil Chunder Dutt*	2466	Yadehalli Krishna Murthy*
2451	Col. Nripendra Singh Bhagat*	2467	Shantilal Maganlal Mehta*
2452	Amullya Dhone Mukherjee	2468	Purushottam Vishwanath Kelkar*
2453	Lt.-Col. Sathanala Petha Joga Rao*	2469	Sundaram Rammohan*
2454	Bajrang Prasad Sangal*	2470	Manindra Nath Das*
2455	Bangalore Seebanna Narasinga Rao	2471	Manoranjan Datta
2456	Natarajamudaliar Muthukumaraswamy	2472	Sarojendra Nath Guha*
2457	Prabhakar Shantaram Sabnis	2473	Panachand Ratilal Parikh*
2458	Brig. Mocherla Kutumba Rao	2474	Ram Lal Khanna
2459	Col. Darabshah Ardshir Mehta*	2475	Shyam Sunder Sarwal*
2460	Maj. Laxmikant Shripadrao Dubhasi*	2476	Gouri Shankar Prasad
2461	Anant Narayan Naik*	2477	Col. Jarnail Singh Sandhu*
2462	B. S. Nagaraj*		

ASSOCIATE MEMBERS

No.	Name	No.	Name
9566	Faqir Chand Kohli	9588	Arunkumar Jayantilal Patwa
9567	Govind Lilaram Hiranandani	9589	Madhukar Patwardhan
9568	C. Lakshmaniyer Ranganathan	9590	Madhav Damodar Gadre
9569	Capt. Surendra Kumar	9591	Gajanan Laxman Kulkarni
9570	Rangaswamy Srinivasan Iyengar	9592	Capt. Charanjiv Lal Chawla
9571	Flt.-Lt. Pulaveri Srinivasa Rajagopalan	9593	Gopal Varadarajan
9572	Yezdezerd Pirojshaw Antia	9594	Shankar Shridhar Dhobe
9573	Bharat Lal Ram‡	9595	Dr. Hoodi Guruv Sundararama Reddy
9574	Vasireddy Rajagopal Sriram	9596	Madhukar Gajanan Deshpande
9575	Indubhai Somabhai Patel‡	9597	Bhaskar Shivram Atre
9576	Prabhakar Kalidas Godbole†	9598	Kishore Chandra Acharya
9577	Homi Dinshaw Patel‡	9599	Ganjigunta Subrahmanya Sarma
9578	Narayan Chandra Som	9600	Prakash Narain Nigam†
9579	Flt.-Lt. Swaraj Chandra Verma	9601	Saifuddin Tayebaly Haidery
9580	Hebbal Venkatesiah Lakshmana Sastry	9602	Annambhotla Venkata Subramanya Shastri
9581	Dhaneswar Patra‡	9603	Gudibanda Srinivasarao Krishnamurthy
9582	Tara Chand Shah	9604	Prabhakar Narayan Vipat
9583	Kadur Srinivasamurthy Anantharamu	9605	Murali Mohan Patnaik
9584	Amarendra Prasad Ray	9606	Nila Kanth Misra
9585	Durga Prasad Nema	9607	Muguru Shankarappa Srikantiah
9586	Gundurao Subbanna	9608	Capt. Inder Sachanand Khilnany
9587	Dinesh Makarand Mehta	9609	Farid Ahmad Siddiqi

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* Transferred from Associate Member

† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No	Name
9610	Mahabir Prasad
9611	Capt. Madhukar Gopinath Diwan
9612	Om Parkash Kapur
9613	Shankar Trimbak Ranade
9614	Babubhai Mathurbhai Patel
9615	Capt. Ishwar Dayal Tyagi
9616	Dwijendra Lal Baisya
9617	Bir Inder Singh Bajaj†
9618	Mukul Mitra
9619	Ramesh Chandra Agarwal‡
9620	Pradipta Kumar Bose
9621	Avinash Govind Pandit‡
9622	Shashi Bhusan Budhiraja
9623	Parkash Chander Bhalla
9624	Ramchandra Shriniwas Kulkarni
9625	Mohan Singh
9626	Ghulam Ahmad Mustafa
9627	Brijnath Koul
9628	Om Parkash Khullar
9629	Tej Ram Gupta
9630	Ved Paul Gupta
9631	Ramesh Chandra Saha
9632	Lokesh Chandra Goyal
9633	Shankar Lal Tak
9634	Pushkar Nath Kaul
9635	R. Krishnamachari Narasimhan
9636	Vishwanath Kedia
9637	Kunduvara Gopalankutty Menon
9638	Durga Prasad Jain
9639	Capt. Vijay Singh Khanwilkar
9640	Capt. Yash Pal Khurana

No.	Name
9641	Natti Kondal Rao
9642	Gurbux Singh
9643	Capt. Leslie Herbert
9644	Oommen Joseph Parackal
9645	Tummala Venugopalarao
9646	Bollampally Sudas Chander Reddy
9647	Alluri Krishnam Raju
9648	Mohomed Abdul Rahim Khan
9649	Pramathnath Rajaninath Gharekhan
9650	Devalapalli Govinda Rao
9651	Sailendra Nath Das
9652	Lt. Kadavil Poulose Kuriakose
9653	Capt. Vidyashanker Dave
9654	Capt. Pundi Ramanujam Narasimhan
9655	Niranjan Vasantlal Shah
9656	Capt. Nuggehalli Gujjegowda Ramaswamy
9657	Shailendra Nanurai Avasthia
9658	Anil Ratilal Bakeri
9659	Satindra Mohan Modak
9660	Priyavadan Anoplal Bakshi
9661	Maj. Surjit Singh
9662	Arvindlal Ochhavlal Shah
9663	Dr. Sachindra Mohan Sen
9664	Raghavendra Kumar Singh
9665	Vinayak Laxman Kerhalkar
9666	Bijan Chandra Ghosh
9667	Bimal Kumar Bose
9668	Abani Mohan Das
9669	Birendra Nath Sinha
9670	Maj. Narayan Nair
9671	Jayantilal Somabhai Chudgar

GRADUATES

No.	Name
1284	D. R. Narasinga Rao
1285	Andrews Joseph Chakramakal†
1286	Arun Chandra Roy†
1287	Abraham Varghese†
1288	Ajoy Kumar Dutta
1289	Shyam Prakash Sabharwal†
1290	Dibyendu Kumar Mukherjee†
1291	Multan Singh Jain

No.	Name
1292	Flt.-Cdt. Charanjit Lal Maggo†
1293	Pamidimukkala Narayana Rao
1294	Gurcharan Singh†
1295	Shankar Lal Mathur
1296	Vasudevaiyer Subramanian
1297	Krishnamurthyrao Vasudeva Rao
1298	Satya Ranjan Kar Roy
1299	Raghbir Singh Dhaliwal

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† Transferred from Student

‡ Transferred from Graduate

GRADUATES (*contd.*)

No.	Name
1300	Rajinder Kumar Mehta†
1301	Eruch Shavaksha Subedar†
1302	Bhasker Navanitlal Adhvaryu†
1303	Balakrishna Narayan Divekar†
1304	Shanti Kumar
1305	Shantilal Manibhai Mistry†
1306	Sub-Lt. Narayanan Hariharan
1307	Sub-Lt. Shri Kant Pawnday
1308	Kishorchandra Thakorlal Desai
1309	Ramamurthi Rajappa
1310	Bhagwati Prasad Gupta
1311	Prem Ballabh Seth
1312	Dilip Ramanlal Patel
1313	Gopikrishna Ramkishandas Dalmia
1314	Rajender Kumar†
1315	Krithivasan Subbaraman†
1316	Gopal Anant Kulkarni†
1317	Nilakantheswar Behera†
1318	Arjun Sahu
1319	Venkataramaiah Venkata Subba Rao
1320	Pazhonayil Chacko Joseph†
1321	Chandraketu Narendrarai Mehta
1322	Mahur Srinivasalunaidu Varadarajulu Naidu
1323	Velangadu Baskaraiyer Gopalan†
1324	Manas Mukherjee†
1325	Vijay Gangadhar Sane†
1326	Ramamurti Rajagopalan†
1327	Madan Lal Taneja†
1328	Sam Wilson Mathias†
1329	Sharwan Singh Mallik
1330	Dharam Pal Suri†
1331	Ramesh Chandra Gupta
1332	Prannath Devraj Modi†
1333	Daya Ram Adoomal Tahilyani
1334	Camillus Shekhar Vincent†
1335	Badro Prasad Guru
1336	Virendra Pal Singh Chauhan
1337	Krishna Narasimhan
1338	Ramanatha Deekshidar Gopalan
1339	Grama Lakshmi Narayana Iyengar†
1340	Goverdhan Lall Sawhney
1341	Krishnaiyer Vaidyanathan
1342	Sub-Lt. Anand Vithal Badve
1343	Rameshchandra Chimanlal Bhavsar
1344	Purushottam Gobindram Bansi
1345	Madhukar Atmaram Phanse†
1346	Nitin Guha†
1347	Pichu Venkataraman Balasubramanian†
1348	Hari Sita Anjaneyulu
1349	Panamgipalli Sangameswara Rao†
1350	Chandoobhai Kashibhai Patel
1351	Boloor Vasudeva Rao†
1352	Krishna Shripadarao Kulkarni†
1353	Pranshanker Chhaganlal Dave
1354	Madamuttanhalli Suryanarayanasastry Srinivasa Sastry†
1355	Prakash Desayi
1356	Mahendra Pal Misra
1357	Sudhansu Kumar Acharya
1358	Fateh Chand Bhopal Lodha
1359	Chandrashekhar Mahadoo Kale†
1360	Plt.-Off. Vaithianatha Krishnamurthy
1361	Prithvi Singh Goyal
1362	Kizhanatham Venkataraghavan Ramaswamy
1363	Shibananda Saha†
1364	Madhusudan Shankar Ambike
1365	Seetharamaiyer Sivaramakrishnan
1366	Mahalingam Sundaram
1367	Virendra Singh
1368	Kamta Prasad Dangiwala
1369	Narayan Das Mukhopadhyay
1370	Kuppuswamy Ranganathan
1371	Sub-Lt. Raj Vir Singh
1372	Ramasami Viswanathan
1373	Puliyur Gopalan Srinivasan
1374	Jaswant Singh Grover
1375	Pankaj Ranjan Basu
1376	Achanta Venkatarama Narayana Rao
1377	Lajpat Rai Jain
1378	Kattipparambil John Eipe†
1379	Tindivanam Panchanathan Ananthapadmanaban†
1380	Hariharaiyer Parameswara Subramania Iyer†
1381	Omprakash Lalaram Ameria†
1382	Padmakar Vinayak Nanal†
1383	Radhakrishnaiyer Sundararaman†
1384	Saligrama Narasimhiah Ramanathan†

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† Transferred from Student

GRADUATES (*contd.*)

No.	Name
1385	Ratilal Maganlal Vora†
1386	Tapan Kumar Basu†
1387	Ram Krishan Gill†
1388	Har Swaroop Singh
1389	T. Ramaiyer Srinivasan
1390	Kuldip Singh Minhas†
1391	Kadayam Ganapathi Sankaran†
1392	Prabodh Gunvantrai Bakshi
1393	Srinivasan Ramamurti
1394	Tirucherai Kandadai Satakopa Ramanujam†

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† Transferred from Student

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

SERVICES OF A RETIRED SENIOR SUPERINTENDING ENGINEER. Government of India, are available as a consultant, for part- or full-time employment, or for liaison work, in connection with all civil engineering works, valuation, contracts, claims, disputes, etc. (Office ref. E.S. 96)

YOUNG EXPERIENCED CIVIL ENGINEER, ex-college professor, desires part-time engagement, mornings or evenings on weekdays for coaching applied mechanics, strength of materials, and theory and design of structures. (Office ref. E.S. 97).

THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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ROADS AND ROAD TRANSPORT*

H. P. Sinha
Member

One of the most vital factors of the modern age is transport. If one thinks about it he will readily appreciate how profoundly it has affected humanity by bringing people together. Roads provide one of the major means of transport and occupy an exclusive and advantageous position in that they reach the door of every user. The ability to deliver the goods from door to door constitutes, many a time, an overriding consideration in economy of transport. This is specially the case in the distribution of consumer goods. In fact, the whole economy of the present day is based on quick turnover of consumer goods. Road transport's share in the movement of goods will, therefore, increase from day to day.

India is at the threshold of an industrial revolution. The major impact of this change has still to come. One of the items to be taken care of is road transport.

Today, there are 400,000 miles of roads in the country, of which 35% are surfaced. The network of roads is still very sparse as will be seen from the figures for other countries for the year 1959 given in Table 1.

Table 1

Country	Road mileage	
	per sq. mile of area	per 100,000 of population
Australia	0.18	5,285
Canada	0.14	3,130
France	3.60	1,704
West Germany	1.64	298
Great Britain	2.02	368
U.S.A.	0.96	1,962
India	0.31	98

The number of motor vehicles in India is even less impressive. The comparative figures with other countries for the year 1959 are given in Table 2.

Table 2

Country	Number of vehicles per mile of road
Australia	4.6
Canada	8.6
France	7.5
West Germany	26.5
Great Britain	30.8
U.S.A.	20.3
India	1.3

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* Lecture delivered at the inauguration of the Roorkee Sub-Centre on August 24, 1961.

I quote below from the remarks made by late Dr. J. C. Ghosh in 1956.

'In the existing roads of 250,000 miles, we find, on the most optimistic calculations, that there are 125,000 trucks plying, *i.e.*, half a truck per mile of road. This figure compares very unfavourably with the figures of 5 to 10 trucks per mile in other parts of the world. This is a matter to which the attention of the Parliament and also the State Governments should be drawn. We feel that roads in India are not being properly used. Empty roads may be a source of delight to foreign tourists or Indians enjoying excursions, etc., but obviously, these empty roads are a question mark to the Indian taxpayer who is persuaded to believe that all his moneys are being used to create utilities and not luxuries.'

Construction of roads is inescapable. Every village must be given a road. The cost of providing such a large network of roads will be enormous. Bringing a metalled road within 4 miles and a *kutcha* road within 1½ miles of each village is estimated to require 657,000 miles of road at a cost of over Rs. 5,000 crores. When such large expenditure is to be incurred, it is prudent to ensure that the roads are sufficiently used to pay back the cost. Road construction then becomes self-financing. Such a position has been attained in a number of advanced countries. The U.S.A. is at present engaged in providing 40,000 miles of inter-State highways at a total cost of about Rs. 12,000 crores. It is expected that the entire capital with interest will be repaid by the vehicles from a single revenue source, the gasoline tax, in about 30 years. This is possible because of the very large number of vehicles in the U.S.A. There is one vehicle for every 2.5 persons and the laden weight of goods vehicle is up to 32 tons. The crux of the problem of road transport, therefore, lies in the production of motor vehicles of all types, from the small passenger car to heavy goods vehicle for carrying loads of 20 to 25 tons.

In our rapidly developing economy, the funds available are not plentiful, with the result that each sphere of activity receives a restricted allotment. Road development is no exception. During the Third Plan, its share is only Rs. 350 crores (including assistance received from International Development Association), which is 4.7% of the total Plan outlay of Rs. 7,500 crores in the public sector. It was 5.4% in the Second Plan and 6.3% in the First Plan. It is not possible to provide roads suitable for heavy vehicles out of this fund.

The Indian Productivity Team on Road Transport have pointed out in their recent report that the productivity of road transport in India is extremely low due to the regulatory and other restrictions imposed on it. To achieve a high degree of productivity in road transport, good roads and heavy vehicles with free flow of traffic are essential. The report adds :

'As against a gross laden weight of 8 to 12 tons permitted for trucks in India, which enables vehicles to carry a load of 5 to 8 tons, the gross weight allowed for combinations in the U.S.A. and Germany is 32 tons so that a load of as much as 25 tons can be carried. Semi-trailers or articulated trailers, which are extensively used in the U.K. and the U.S.A., usually carry 17 to 21 ton consignments. In Germany, a heavy truck usually tows a drawbar trailer equipped with turntable and power brakes. The truck has two and the trailer three axles, with a combined carrying capacity of 25 tons.

The use of the above combinations has cut road transport costs by as much as 77% in the past two decades. Taking the 6-ton lorry now in use in India as the standard, the operating cost can be reduced by 40% by using a 13½-ton unit, 47% by a 18-ton unit, 66% in the case of a 22½-ton combination, 73% by a combination carrying 27 tons, and 77% by a unit carrying 32 tons. It is these combinations that constitute the backbone of road transport productivity in the West.'

Heavy vehicles require roads with thickness of hard crust of the order of 18 to 20 in. against the present available thickness of 10 to 12 in. They also require superior surfacing than the present surface painting, and lastly, they cannot ply with safety on a single lane width of 12 ft. The roads have to be widened to provide at least two lanes.

Since these improvements are not possible at present, the use of very heavy vehicles is prohibited and therefore the cost of road transport cannot be reduced. The high cost of road transport prohibits the increase in demand of vehicles, and so the revenue from vehicles continues to remain low.

The modern age requires development of all kinds of transport to cope with the ever increasing need for interchange of goods and ideas. As an exemple, the distribution of total traffic in the U.S.A. in 1958 was :

Railways	..	47%
Roads	..	20%
Inland water transport	..	16%
Pipeline	..	17%

It will be necessary in India to develop all the major means of transport to the maximum to avoid holdups in progress. The impression that means of transport can develop only at the cost of others is completely unjustified. The Chief Engineers of all the States and the Centre assessed the requirement of transport for the next 20 years (1961-81). They presented a report on the 20-year road development requirements, which indicates the distribution of traffic between rail and road transport. They came to the conclusion that long distance transport (average 300 miles) will increase from 182 million tons in 1960-61 to 800 million tons in 1980-81. At the end of the Second Plan, the railways were expected to carry 162 million tons. There was, thus, a gap of 20 million tons which had to be carried mainly by road transport. Similarly, it was assessed that at the end of the Second Plan, railways will carry 523 million tons and roads will be required to carry about 246 millions tons, *i.e.*, 10 times of what they carry today.

The number of motor vehicles that should be produced each year for meeting the demands of road transport was also calculated. The revenue that would be available to the Covernment from these vehicles and the expenditure on development of roads to maintain adequate standards was worked out. It was estimated that the total expendi-diture on roads over this period should be of the order of Rs. 5,200 crores for development and Rs. 1,350 crores for maintenance. It is expected that the revenue from motor transport taxation will be about Rs. 6,150 crores, which means that the entire programme can be self-supporting.

According to the report, the expenditure on road development during the next 20 years should be of the following order :

Third Plan	(1961-66)	.. Rs. 590 crores
Fourth Plan	(1966-71)	.. Rs. 1,065 crores
Fifth Plan	(1971-76)	.. Rs. 1,545 crores
Sixth Plan	(1976-81)	.. Rs. 2,000 crores

The Third Plan, however, provides only Rs. 272 crores for road development, although it has been stated that the programming of works can be taken up for Rs. 320 crores, in the hope that if there is a saving elsewhere, the road development sector will be given additional funds. Recently, the International Development Association have agreed to give India a credit of 60 million dollars (Rs. 29 crores). This money will be utilized for construction and improvement of National Highways near Calcutta and Bombay.

An unbalanced road development with concentration of work on the higher types of roads only will not produce a smooth flow of traffic. To start with, low cost roads have to be formed with earth and gravel only, but even earth and gravel roads require regular maintenance. Although there is large unemployment in the country, it will not be possible to obtain the requisite manual labour in time for the maintenance of a large system of low cost roads. The only alternative then is to mechanize the construction as well as the maintenance of such roads. The equipment required include road rollers and motor graders. The former are being manufactured in the country but the latter have to be imported. It is hoped that the manufacture of motor graders will be undertaken soon to fulfil the urgent need for construction and maintenance of earth and gravel roads.

I have talked at length on the problems of road transport because it is essential to highlight these problems at the present time. Unless these are solved within the next few years, we will be heading towards a great bottleneck in transport and it will not be possible to evenly distribute the manufactured goods over the country. The usual method of road construction consists of forming a bank with the soil available along the road alignment, laying a soling coat, one or two metalling coats, and then painting the surface with bitumen or tar. The surfacing is rarely of a superior nature such as bituminous carpet or a concrete pavement. The thickness of the road crust, *i.e.*, the soling and the metalling, is arrived at on the basis of a thumb-rule of 6 in. stone soling or one or two flat brick soling, a 4½ in. coat, and sometimes a second coat of 3 in. thick metalling. This design was adequate for the light traffic in the past. With heavier loads now coming on the roads, this crust thickness is inadequate. It is now necessary to make use of all the components of roads, including the soil, to obtain the most economical design. The soil bank has to be compacted scientifically to 90 to 100% of Proctor density. For design purposes, this compacted soil is generally assumed to be in a saturated condition so that it may not yield under load during the monsoon season. In saturated condition, most of the alluvial soils have a low C.B.R. value. Taking this value the required thickness of the crust is worked out on the basis of repetition of wheel loads of vehicles exceeding 3 tons in gross weight. Lighter vehicles have little effect on road crust. The failure of roads does not take place due to the intensity of an isolated load. It is the repetition of the loads that brings about the failure. The thin crust of the old pavements have stood the traffic so far only because the number of repetitions of heavy wheel loads is still low. This, however, cannot last for long. Already several arterial routes, specially in the vicinity of large towns, have started showing signs of distress and the road surface is getting deformed rapidly.

The thickness of the crust depends on the C.B.R. value of the soil. For a poor soil having predominance of clay particles, the C.B.R. value may be 2 to 3%. The thickness of crust for medium traffic, *i.e.*, the number of vehicles of more than 3 tons laden weight numbering about 1,000 per day, would be 27 in. For the same traffic, if the C.B.R. value is about 8%, the thickness required is only 13 in. This shows how essential it is to get a high value of C.B.R. from the soil. The soil can be improved either by using an admixture of granular materials or by treating it with cement, lime or other additives. It is cheaper to improve the soil than to provide full thickness of crust for a poor soil. In a modern road, therefore, earth formation is one of the most important components of the structure. The compaction or stabilization of soil, however, cannot be satisfactorily done with manual labour for large scale works because the operation requires rigid control at all stages. Mechanical equipment has, therefore, to be used for earthwork in the same way as is done for earth dams. We could not so far embark on this type of construction because appropriate equipment of indigenous manufacture are not available and sufficient foreign exchange is not available for their import. In order to get over this shortcoming as far as possible, stage construction of roads is being followed, *i.e.*, a road is first constructed with a thin crust of one layer of soling and one layer of metalling. The traffic is allowed to compact the road for a few years and then a second layer of metalling is laid. Since the final compaction of the soil takes a long time in these circumstances, the road surface never remains true. This defect has to be accepted under the circumstances in the country. However, a beginning will be made for proper road construction in future projects with the assistance of a loan from the International Development Association, as mentioned earlier. The full thickness of the crust will be laid in the first instance after compacting the embankment to the design standards. These roads will form the model for future roads in many respects.

Another aspect of the design of roads is the width of pavement. So far, no attempt has been made to provide the width in accordance with the need of traffic. This is partly because the volume of traffic is still quite low, but mainly because of the paucity of funds. Even on the National Highways, only 2,300 out of 15,000 miles have more than one lane of pavement. In the Third Plan, there is very little provision for widening of the roads. If all the National Highways and one-half of the State Highways are widened to two-lane width and the pavement thickness increased in accordance with the requirement of the intensity of traffic, a sum of Rs. 200 crores will be required. Nevertheless, this work will soon become imperative in the context of the rapid growth of traffic both in volume and weight. Delay in this work is bound to lead to increased toll of life from traffic accidents. Already several stretches of roads, mainly near Calcutta and Bombay, have become extremely congested. The existing roads which have two lanes are inadequate. At Bombay, the construction of two stretches of expressways is in hand at a cost of Rs. 5.2 crores, and the proposal for an expressway at Calcutta is under consideration.

Considerable thought has been given to the lane capacity of roads. In advanced countries, the lane capacities (primarily for motor vehicles) are reckoned as given below.

Type	No. of vehicles per hr. per lane
Single-lane two way road	300
Double-lane two way road	450
Three-lane two way road	500
Four-lane divided carriageway	1,000

For Indian conditions, these figures have to be modified because the character of traffic is different from that in advanced countries. Not only the percentage of slow traffic is higher in India but the slowest moving vehicle, *i.e.*, the bullock-cart, causes more obstruction to the flow of traffic than the slowest vehicle in other countries. A single lane may be sufficient for 1,000 equivalent vehicles per day, worked out from the formula

$$C = 1.5T + 3B$$

where C = number of light motor vehicles, T = number of heavy trucks or heavy vehicles, and B = number of bullock carts.

Three-lane carriageways are not considered desirable. In fact, as soon as the volume of traffic exceeds the figure for two lanes, it is desirable to provide a four-lane divided carriageway, having two lanes of pavement on either side of the central verge.

The volume of traffic that a road can pass depends on the speed at which vehicles can travel over it. The highest average speed can be attained only on divided carriageways where the 'in' and 'out' traffic have been segregated. But this speed can be maintained only if there is no obstruction at crossings with other roads. Level junctions are, therefore, a source of hindrance to fast moving traffic. Grade separations, *i.e.*, one road going over the other, have to be provided at all crossings on high standard roads. But the cost involved is very high, and in many cases, within a town area, it works out to Rs. 1 crore per mile, because the roads run on a viaduct for a major portion of the way, and all slow moving traffic have to be separated to a different pavement. Such expenditure is, however, fully justified for congested areas where the volume of traffic is very heavy. In the U.S.A., where road travel is most intense, death rate by accidents dropped from 11.4 deaths per 100 million vehicle miles of travel in 1940 to 5.4 in 1959.

In the end, I would say that it is necessary to become fully conscious of the needs of roads because they will have to carry larger traffic as the industrial programmes progress. If we fail to provide adequate roads in time, there will not only be a great congestion in the movement of men and material, but also the accident rate will mount up and many lives may be lost. Major road projects which include the construction of bridges require about five years to plan and execute. The requirements of traffic have, therefore, to be anticipated well in advance to prevent critical situations.

Contemporary World Engineering Projects Series—17

Members are invited to contribute to this Series special articles featuring major engineering projects which they may have visited or with which they may have been associated in any other manner. Articles should be preferably accompanied by photographs and illustrative sketches.

HOUSING DEVELOPMENT AT ROEHAMPTON LANE, WANDSWORTH*

The comprehensive development of a number of large sites in the Putney-Wimbledon area was decided upon by the London County Council in 1948. A detailed scheme of development for one of the important sites, Roehampton Lane, was approved in 1953.

The site

The site, which covers nearly 100 acres of parkland and gardens, has much of this character retained in the developed area. Out of this, about 70 acres are used for housing. The site is situated with a frontage of nearly one mile on the north side of Richmond Park (Fig. 1). A stream, which has now been culverted and replaced by the main spine road following its course, flowed through a valley from one end of the site to the other. To the south of this valley, the site rises up gently and falls away into Richmond Park. On the north side, the ground rises steeply towards Roehampton Lane and Clearance Lane.

The land acquired by the Council included certain historical buildings (Mount Clare and Downshire House) which have been preserved. Another factor which affected the layout design was the existence of a well established shopping centre in the Roehampton village.

Planning and layout

The problem of achieving a density of 28 dwellings (100 persons) per acre was solved by using a mixed development of flats, maisonettes and houses, which are grouped in separate areas as follows :

(i) Fifteen 12-storey point blocks (660 flats) with two two-room flats and two three-room flats on each floor, and the ground floor having stores, refuse chamber, hall, lifts and stairs.

(ii) Five 11-storey maisonette blocks (375 maisonettes) and one 10-storey block of 45 maisonettes and flats in the shopping centre near Roehampton village. The maisonettes are served by access galleries, a single public staircase and two lifts.

(iii) 26 four-storey maisonette blocks (558 maisonettes), and 25 maisonettes and 20 flats over shops.

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* Compiled from publications made available by the courtesy of the London County Council.

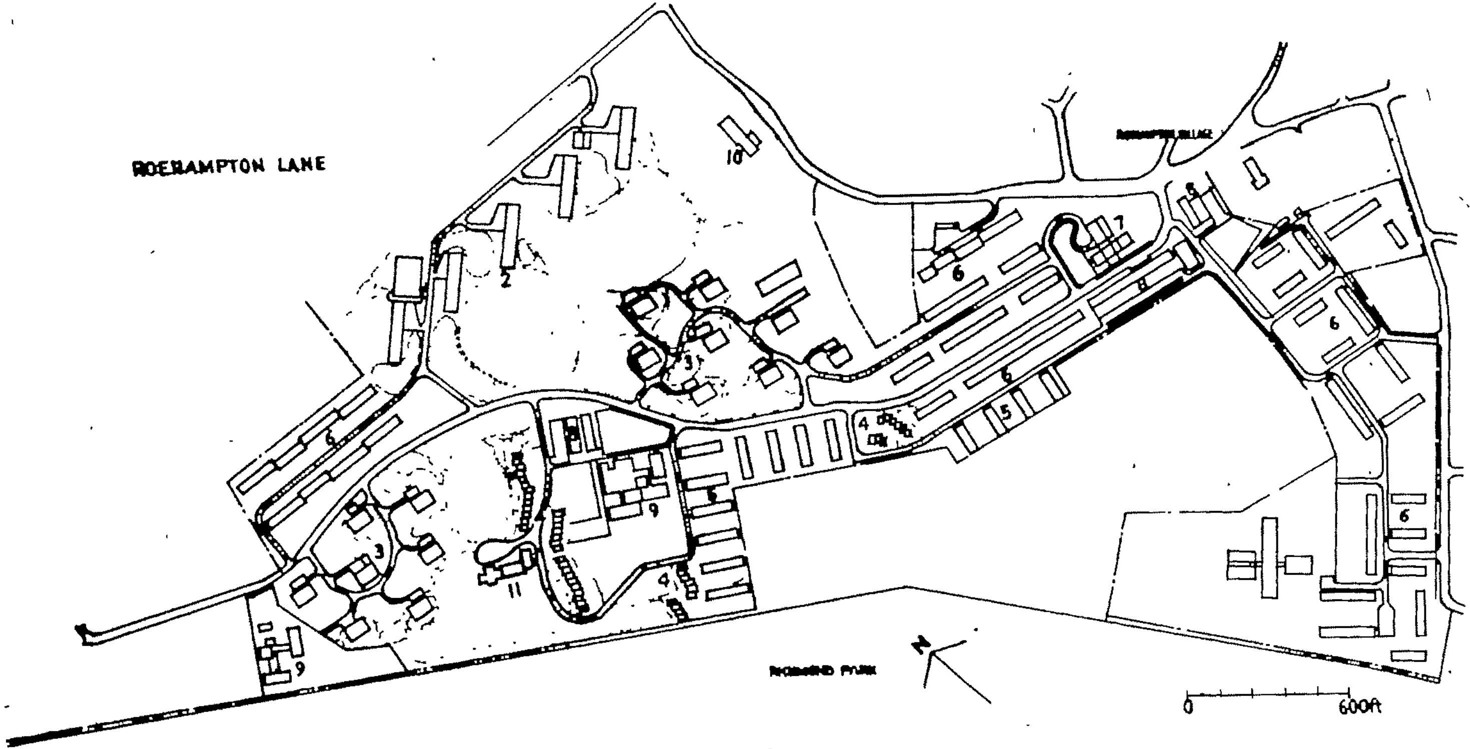

Fig. 1

Site layout of the housing development at Roehampton Lane, Wandsworth

1, Boiler house ; 2, 11-storey maisonettes ; 3, 11-storey point blocks ; 4, Old people's dwellings ; 5, Two-storey houses ; 6, Four-storey maisonettes ; 7, Library ; 8, Shops and three-storey maisonettes ; 9, Schools ; 10, Downshire House ; 11, Mount Clare House.

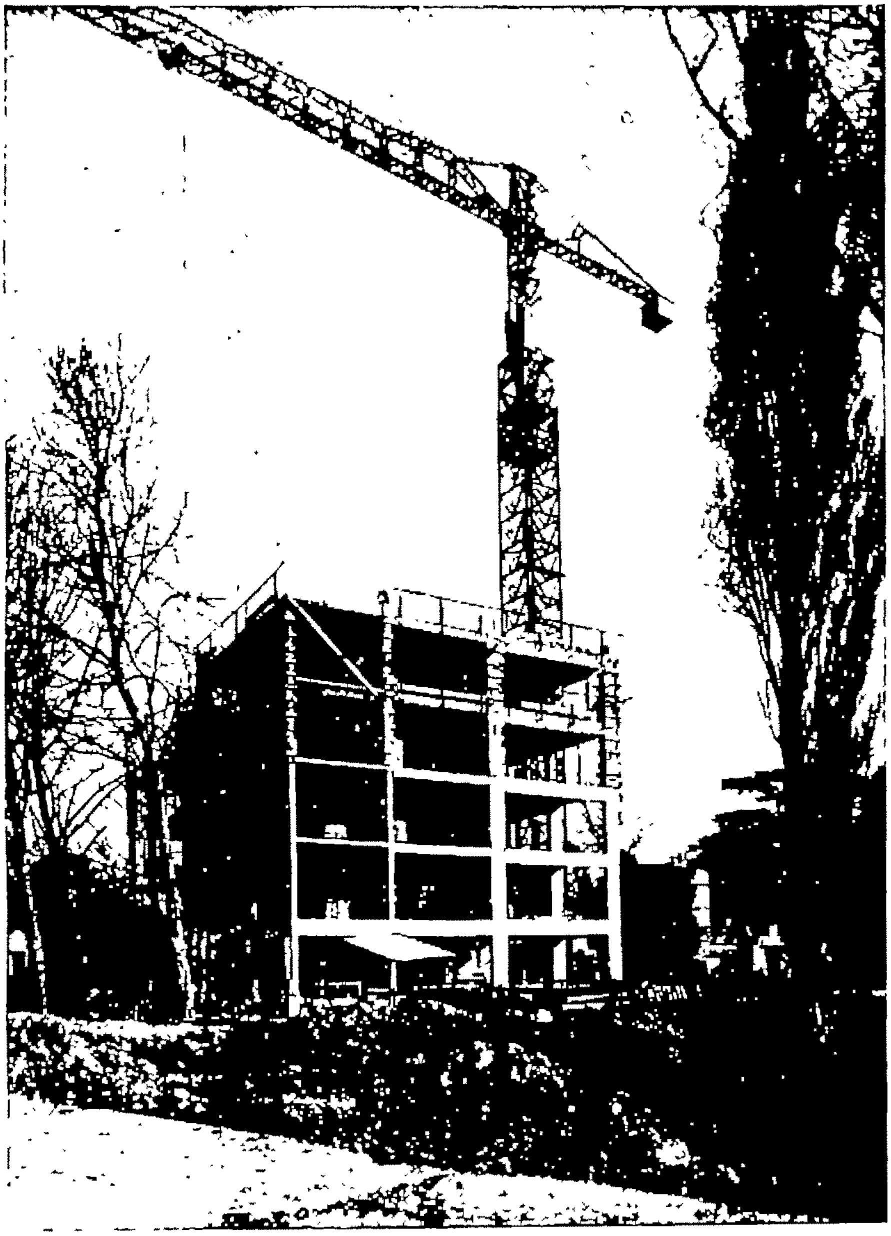

Fig. 2

Block 8, 12-storey flats (fourth floor level) under construction

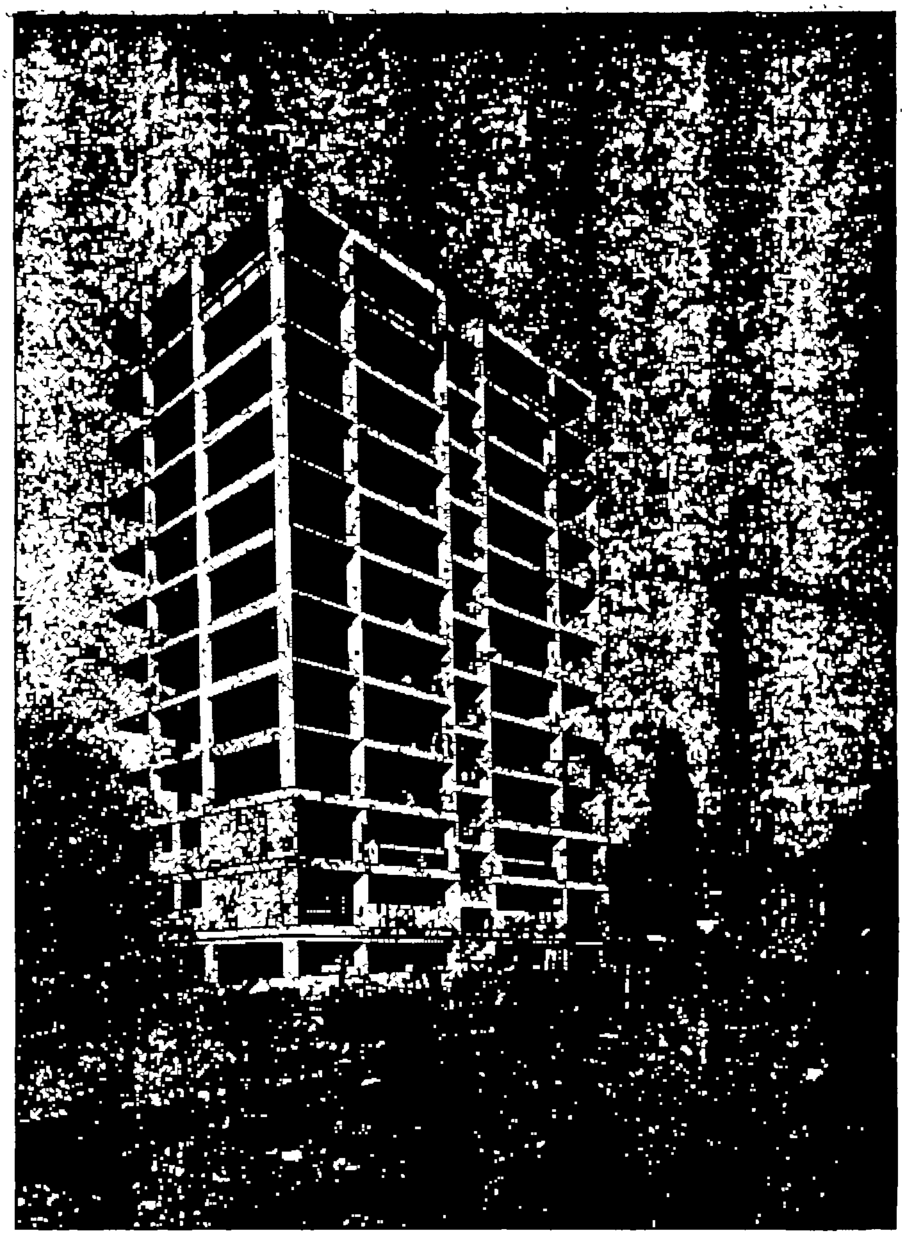

Fig. 3

Block 8, 12-storey flats showing commencement of cladding

Fig. 4

A view of the 11-storey maisonettes during construction

(iv) 28 three-storey terrace houses, having three bedrooms, living room and dining kitchen. A store is provided on the ground floor near the front entrance for fuel, dustbins, etc. The design is contained within a 13 ft. frontage.

(v) 104 two-storey terrace houses having four bedrooms, living room and dining kitchen.

(vi) 49 single-storey houses for old persons. These are designed on a system of staggered party walls to make them fit into heavily wooded undulating parts of the site.

(vii) One warden's house and club room.

(viii) 26 shops, 73 garages, and one public house.

(ix) Two doctor's surgeries.

Besides, there are schools, a church, a health centre, a community centre, main and subsidiary shopping centres, and a club for old people.

Heating and hot water

Central heating and domestic hot water is provided for the high maisonettes and point blocks by a central oil-fired boiler plant. This has been made economically practicable by the large number of units served and the way in which they are grouped.

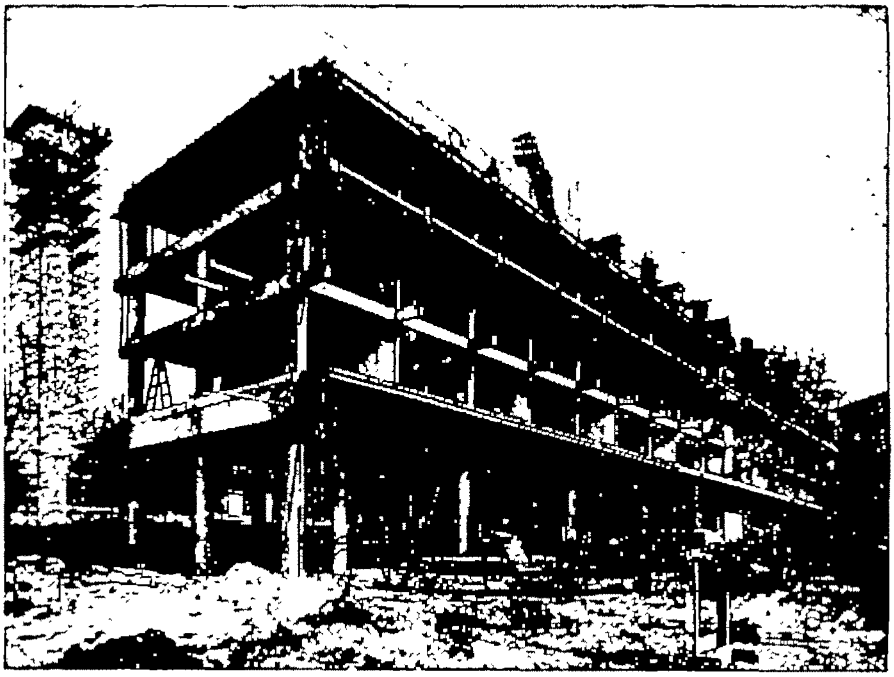

Fig. 5

Block 1, 11-storey maisonettes (fourth floor level) under construction

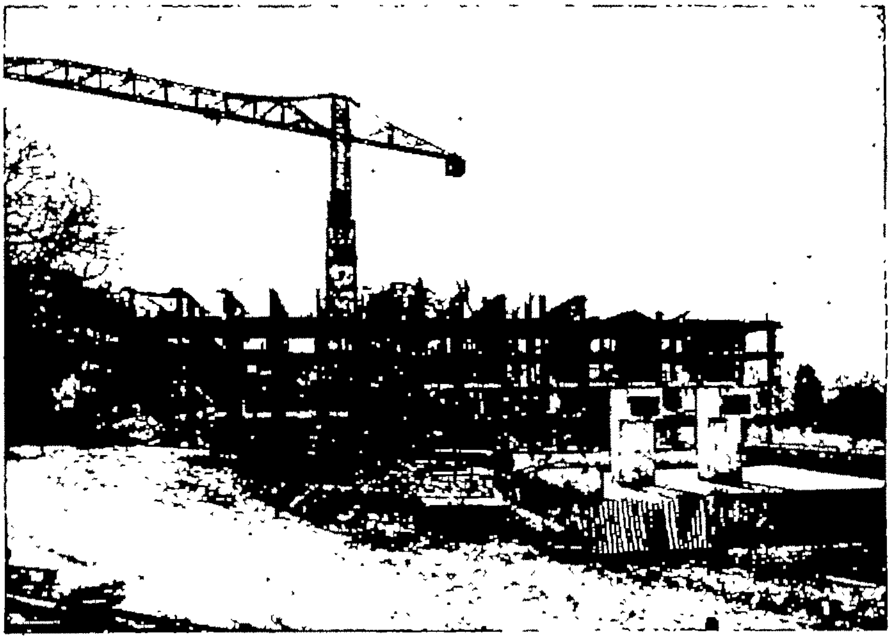

Fig. 6

11-storey maisonettes with boiler house in the foreground

The heating scheme has been designed to serve not only the 1,035 dwellings in the 11 and 12-storey blocks but also the two primary schools, the nursery school, the old people's club, the maintenance depot, and the existing Downshire and Hartfield Houses. The boiler house is sited near one of the 11-storey blocks. The concrete chimney of the boiler house is built free-standing near the flank wall of the block.

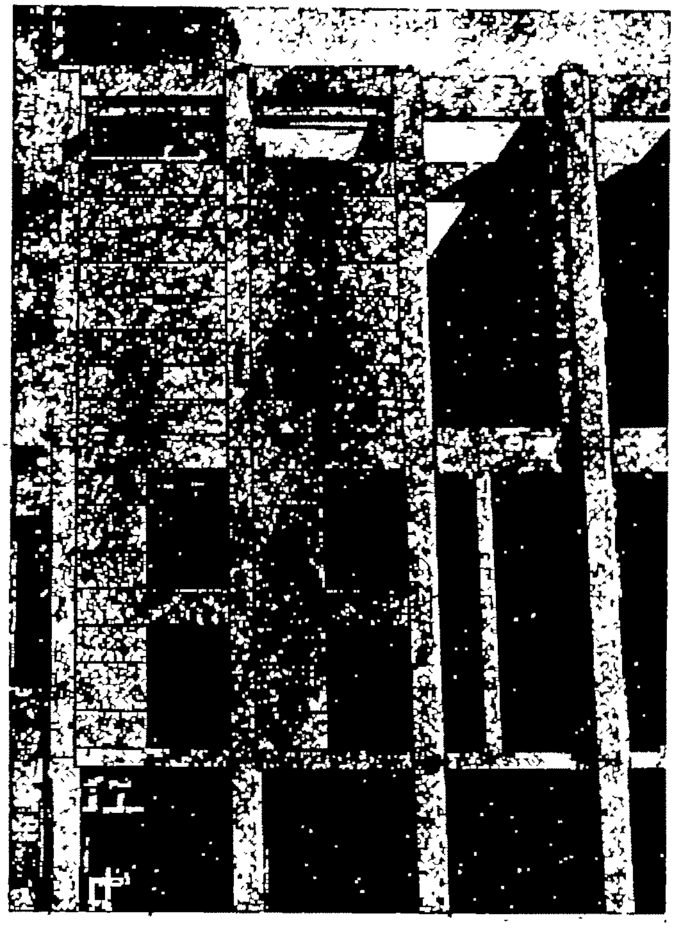

Fig. 7

Details of cladding

Design and construction

Point blocks and 11-storey maisonette blocks

The point blocks are designed with a normal reinforced concrete frame structure. The maisonette blocks are designed with a combination of reinforced concrete frame and load bearing wall, the loads being carried down at ground floor level on to circular columns. In order to take full advantage of site erection techniques, the contractors, in cooperation with the architect and engineers, precast on the site such items as horizontal floor beams, balconies and staircases, which considerably improved the speed of erection.

With the help of tower cranes, all major components were handled directly on to the building without external scaffoldings. The precast concrete cladding was delivered straight from the factory by trucks and unloaded into its final position on the building. It then only remained for an operative to make certain adjustments, and for the mastic joints to be made on completion, which was done from a travelling cradle. The staircase flights were similarly handled and all major components were loaded on to the floors as the work proceeded.

The foundations of the multistorey blocks created special problems. Owing to the proximity of Mount Clare, an old historical building, special precautions were taken to ensure that the vibrations due to pile driving did not damage the structure or the very fine plaster ceilings of this building. Tests were carried out and the effects were scientifically measured so as to ensure that there were no harmful effects as a result of the piling operations.

Serious problems were encountered, however, with the behaviour of the piles when driven. The nature of the subsoil gave rise not only to 'ground heave', but also to the movement of the piles themselves, due to the plastic condition of the soil. These difficulties were met by increasing the length of the piles which were redriven on completion.

Full heating in living rooms and background heating in bedrooms is provided by convectors served with hot water from a fully automatic oil-fired boiler plant housed in a central boiler house of unusual design (based on the design of a ship's boiler house) and incorporating a 121 ft. high concrete chimney. Domestic hot water is also heated in the same plant by means of an indirect cylinder in each flat. The hot water for both services is pump circulated to all blocks through an inverse return ring main distribution system around the site. The ventilation system consists of internal ducts leading from all bathrooms and W.Cs. to extraction fans in the roofs. A similar system provides mechanical extract ventilation for the drying cabinets provided in each dwelling.

The external cladding used for both the point blocks and the maisonettes consists of large scale vertical floor to ceiling units which were hoisted into position and rest on horizontal stringer units which are previously bedded and bolted to edge beams at floor levels, all joints being subsequently caulked and painted in mastic. The external finish was produced by exposing an aggregate consisting of a mixture of Derbyshire spa and Dorset shingle. Concrete columns and beams at ground level, roof houses, and lift motor rooms are left with a board finish without further treatment.

Four-storey maisonette blocks

The four-storey maisonette blocks are constructed of loadbearing cross walls, 9 in. thick, in calculated brickwork on normal strip foundations, with solid *in situ* reinforced concrete floors and roofs. The main staircases are constructed in reinforced concrete; the individual staircases within each unit are of timber construction.

Terrace houses and old persons' dwellings

The terrace houses and old person's dwellings are constructed with brick cross walls and timber floors and roofs spanning longitudinally between stool cross beams in the case of the two-storey houses and spanning direct between cross walls in the case

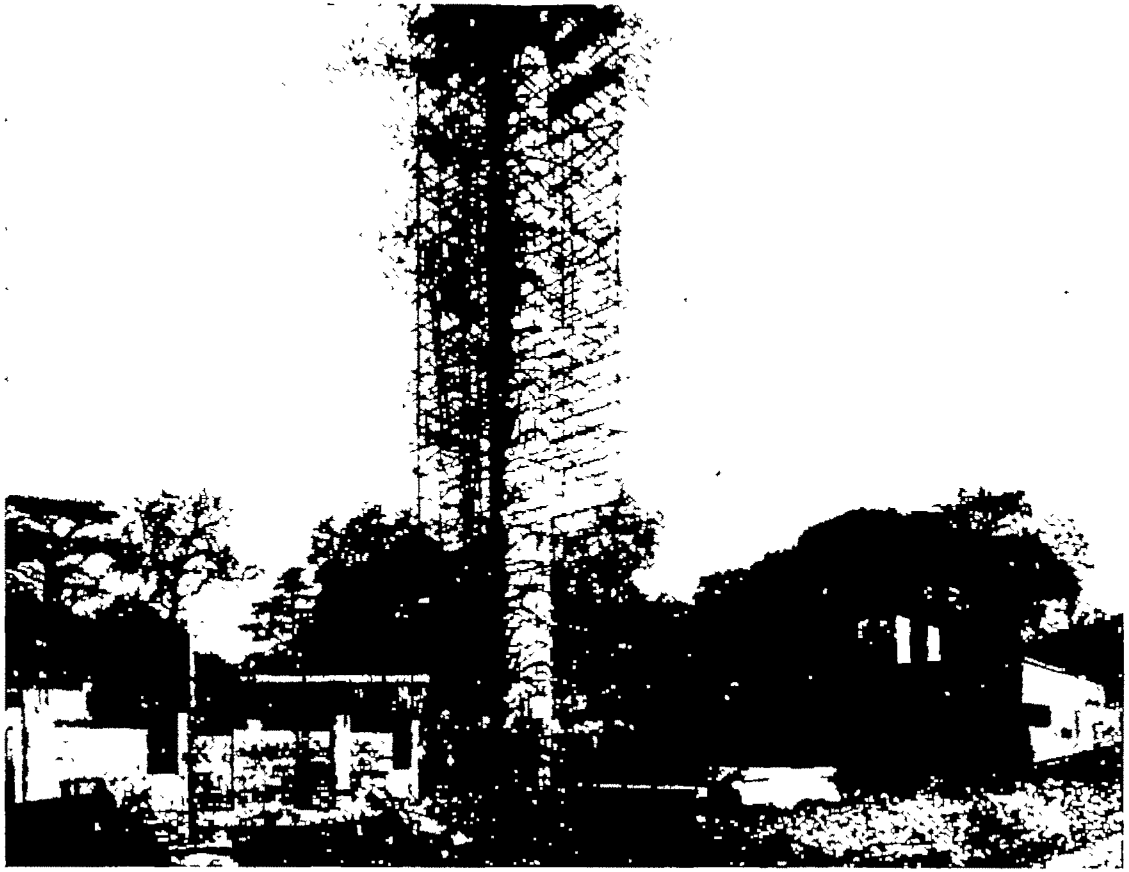

Fig. 8

Construction of boiler house and chimney of the three-storey houses and old persons' dwellings. The edge beams and fascias to the three-storey and two-storey houses are of reinforced concrete, those to the old persons' dwellings being of timber.

Buildings in main shopping centre

The building in the main shopping centre are of reinforced concrete framed construction with hollow tile floors and roofs. The external cladding to these blocks is similar to that used for the point blocks and 11-storey maisonettes. The staircase towers to these blocks are of reinforced concrete construction and are designed to be independent of the main structure, the staircase flights being cantilevered from a central 'fin' containing refuse chute and service ducts.

Summaries of Papers Published in the Journal, vol. 42, no. 4, pts. EL 2, GE 1 & HI 1, December 1961

ELECTRICAL ENGINEERING DIVISION

Radio Interference Characteristics of Insulators

C. V. Doreswamy
Non-member
and
Prof. D. J. Badkas
Associate Member

The paper gives the results of the radio interference characteristics of insulators under various atmospheric and humidity conditions. Empirical equations to explain the correlation between the mains voltage and the radio interference voltage are given.

The phenomenon of radio interference has been mostly investigated either for conductors or for completely built-in transmission lines. Not much data is available as regards the characteristics of individual materials and insulators. The study was undertaken to investigate the interference characteristics of materials and insulators used in the design of extra high voltage transmission lines.

Practical Method of Design of Hydro Generators

S. H. Raj
Associate Member

In meeting the requirements of our power projects such as generators, transformers and switchgears, the country is experiencing a heavy drain on its foreign exchange and the time has come when the country has to start the manufacture of small and medium size electrical equipments itself. This however requires precise knowledge of the techniques and technical knowhow of these machines, in addition to planning for efficient translation of the designs from the practical viewpoint as well. The paper briefly discusses a typical practical method of design of heavy duty hydro alternators, in an attempt to focus the attention of engineers concerned in such job handling, on the initial problems that have to be encountered in the design and manufacture of heavy electrical equipment in the factories.

GENERAL ENGINEERING DIVISION

Technologists and Scientists in Administration

Baleshwar Nath

Member

An attempt is made in this paper to disprove the assumption that scientific and technological talents are wasted if they are to permeate to administrative positions. The disadvantages and dangerous results that may follow by allowing the bureaucrats to head the scientific and technical experts are outlined. It is argued that power and responsibility when united in one person will give him the strength of eleven; whereas when separated it may lead to demoralizing situations. In technological and scientific work, one person alone can be the expert and he is certainly not the layman-administrator.

Equipment Replacement Policy and Mapi Formula

S. B. Rao

Associate Member

Deterioration of the assets of an organization directly affects production. An important question every modern industry has to face is whether its existing assets are sufficient to serve the purposes they are intended for or whether they require replacement, and, if so, at what intervals, in order that the production and the quality of the service are maintained and the revenue realizable ability of the assets is kept up.

Attempts have been made by several authorities to tackle this important problem, but none of these is satisfactory. However, of these, the 'Mapi' formula, which is discussed in detail in this paper, is found to be comprehensive in that it takes into consideration the many interrelated factors which have direct bearing on the replacement of an asset in a dynamic equipment policy, but this too has its own limitation.

HINDI SECTION

Magnetic Amplifiers

Dr. H. R. Chablani

Associated Member

The paper traces history of the development of magnetic amplifiers. Magnetic amplifiers are being increasingly used in industrial measuring instruments and servo controls for industrial and military equipment. They are being used independently as well as in conjunction with transistors or electronic amplifiers. It is shown that magnetic amplifiers are best suited for conditions: (i) where reliability and ruggedness are required, *e.g.*, in military equipment, (ii) where prolonged and continuous use is required, *e.g.*, in industrial equipment, (iii) where linear characteristics and high accuracy are desired, *e.g.*, in measurement and control of temperature, pressure, intensity of light, etc., and (iv) where isolation of the load circuit from the control circuit is essential, as is preferred in a majority of indicating instruments. The paper also gives briefly the characteristics of core materials suitable for magnetic amplifiers.

Use of Seasoned and Treated Timber in Construction

G. C. Mathur

Non-member

The paper emphasizes the use of secondary species of timber in construction to relieve the shortage of timber in the country. It is explained that this is possible only when such timbers are seasoned and treated before use. This establishes the case for setting up of seasoning and treatment plants at different places in the country. The advantages of seasoning and treatment of timber, are explained and the schemes that have been prepared for setting up seasoning and treatment plants in the country are indicated.

Rural Problems—4 : Roofing Problem

Vishwambhar Prasad

Associate Member

In this fourth part of the paper, design and construction of roofs, flat as well as pitched, suitable for villages are discussed. Principles of reinforced concrete (R.C.C.) and reinforced brick (R.B.) work are explained with a view to acquaint non-technical persons also with the techniques of roofing. A 24 ft. span R.C.C. roof truss is described to serve as a model.

This paper supplements the first part of the paper in which a cheap design of a roof utilizing indigenous materials like *balli* and bamboo were suggested with a view to enable the villagers to construct, without much technical aid, a complete one-room unit at a cost of Rs. 1,500, and add two more rooms and a verandah at an additional cost of Rs. 1,000. Graphs, drawings and illustrations are presented with the help of which R.C.C. and R.B. slabs, and R.C.C. roof trusses can be designed quickly and conveniently.

INSTITUTION NOTICES

Changes to the Programme of Paper Meetings, 42nd Annual Convention, Calcutta, February 1-8, 1962

Mechanical Engineering Division

The Symposium on 'Machine Tools and Metal Cutting,' which will commence on February 6, 1962 at 9.00 a.m., may be continued on February 7, 1962, at 2.30 p.m., if necessary.

Electrical Engineering Division

The Symposium on 'Power Supply in India', which will commence on February 6, 1962, at 9.00 a.m., may be continued on February 7, 1962, at 2.30 p.m., if necessary.

Electronics and Telecommunication Engineering Division

The Symposium on 'Transistors and Semi-Conductors in Communication and Electronics' will be held on February 5, 1962 at 9.00 a.m. instead of February 6, 1962.

The paper meetings in this Division which were scheduled for February 5, 1962, will now be held on February 6, 1962 at 9.00 a.m.

Structures Group 2—Shell Structures

Paper Meetings in the Structures Group 2—Shell Structures will commence on February 7, 1962

Popular Lecture

A Lecture is being arranged on Tuesday, February 6, 1962, at 7.00 p.m. The name of the Lecturer and the subject will be announced later.

Award of prizes for 1959-60

The following prizes have been awarded for the year 1959-60.

(1) The Union Ministry of Irrigation and Power Gold Medal and Cash Award

The Union Ministry of Irrigation and Power Gold Medal and Cash Award for the best paper on power development and utilization has been awarded to Shri M. Hayath (*M.*), for his paper 'Power Projects' published in the *Journal*, vol. 41, no. 5, pt. 2, January 1961. The author is Director (Technical), Heavy Electricals Ltd.

(2) An Institution Prize

An Institution prize has been awarded to Shri C. L. N. Iyengar (*A.M.*), for his paper 'Evaluation of Rigid Pavement Performance with Special Reference to Airports', published in the *Journal*, vol. 41, no. 3, pt. 1, November 1960. Shri Iyengar is with the Concrete Association of India, Bombay.

(3) An Institution Prize

An Institution prize has been awarded to Sarvashri N. Majumder (*A.M.*) T. B. S. Prakasam (*Non-member*) and M. V. Suryaprakasam (*A.M.*), for their paper 'A Critical Study of Septic Tank Performance in Rural Areas', published in the *Journal*, vol. 40, no. 12, pt. 1, August 1960. The authors are with the All-India Institute of Hygiene & Public Health, Calcutta.

An appeal to members for contribution of technical papers to the *Journal* of the Institution

Members' attention is invited to the following appeal issued by Shri T. R. Mehandru, Chairman, General Engineering Division :

'Corporate Members are aware that dissemination of technical knowledge through publication of high standard technical papers in the *Journal* of the Institution is one of the major technical activities of the Institution ; and the papers that are published are judged by outsiders by their quality and number. Since it may not be possible, for various reasons, for many of our members to be personally present at the lecture meetings organized by their Local Centres, they can only benefit by reading, at their convenience, the papers published in the *Journal.*

May I again very earnestly appeal to the members to contribute papers on subjects of their specialization, particularly buildings, housing, slum clearance, city improvement, town planning, and allied subjects and send them in triplicate to the Headquarters Office in Calcutta. Papers which merit publication will be taken up for the *Journal,* and various prizes are annually awarded to the authors for papers which are considered to be of special merit and interest.'

INSTITUTION NEWS

Opening of a new Sub-Centre at Bhilai

As approved by the Council at their 419th Meeting held at Bangalore on May 10-11, 1961, a Sub-Centre of the Institution was opened at Bhilai. Shri L. N. Misra (*M.*) and Shri K. M. Kukereja (*A.M.*) were elected Chairman and Honorary Secretary respectively. The Sub-Centre was inaugurated on August 25, 1961 by Shri Phiroz Kutar, Director (Production), Hindustan Steel Ltd., at a function held at the Bhilai Technical Institute Hall of the Bhilai steel project. The function was attended by large number of members and guests.

Shri Suku Sen, General Manager, Bhilai steel project, welcomed the members and guests and said, 'It is my proud privilege this morning to welcome you in the township of Bhilai steelworks. I thank you for extending to me this opportunity. The status, activities and importance of the Institution do not need any introduction. That is why I feel that today's function has a far reaching effect. Before independence, 14 years back, it was up to lawyers, doctors and politicians, may be some engineers also in their personal capacity, to fight for the goal of attaining freedom. But today, the onus, the responsibility, and the task of making a progressive nation, has fallen on the shoulders of engineers. When I say engineers, I am referring to the term in a very broad sense. I am not referring to the only few fortunate ones who could graduate from universities. I mean every technician in all the industries involved, as is done in every industrially advanced country. The Institution, I am glad to note, has room for all types of engineers as defined by me, post-graduates, graduates, undergraduates and apprentices. Furthermore, it has excellent facilities for these people to advance their technical qualifications. It is very satisfying to observe that Bhilai is very rapidly developing into a centre of exchange and dissemination of technical knowledge. No industry can progress unless there is continuous interchange of ideas and developments. That is why the function of the Institution is so important and useful. I would like to mention that in an integrated steel plant, such as Bhilai, this is the forum where engineers of different groups can meet together to run the plant successfully. All the engineering sciences are really geared into one in an integrated steel works. With the opening of the Sub-Centre, Bhilai will form a direct link with the world,

SHRI PHIROZ KUTAR DELIVERING THE INAUGURAL ADDRESS

and other engineers in the profession. I am sure this Sub-Centre will be a most useful member of the parent today. I am, however, glad to make an appeal to the Sub-Centre to devote its enterprise and energy more pointedly towards development and advancement of steel technology.

I welcome everybody here and wish the Sub-Centre every success.'

Shri Phiroz Kutar then addressed the gathering and declared the Sub-Centre open. Delivering the inaugural address he said, 'The subject I have chosen for the inaugural address is 'Engineering Education in India'. I think the inauguration of the Bhilai Sub-Centre deals with a very important subject of engineering education. The first Sub-Centre of the Institution in the public sector steel plants is in Bhilai. I sincerely hope that Durgapur and Rourkela will follow the example of Bhilai. I am very happy that Bhilai has taken the lead to become the first in production, second in cost, and third in making profit, while the other steel plants are showing loss. But, at the same time, I must say that from the country's point of view and from the point of view that the public sector steel plants have to compete with the private sector, it is very essential for us to produce steel as economically as possible. You will realize that the interest on capital and the depreciation has not been taken into account. I am quite sure that Bhilai will be the first in showing a profit even after taking these into consideration.

I feel that the future of industrialization in the country rests in the hands of young engineers. It is a big challenge because we are industrializing at a fast pace. It is a challenge to fulfil our part and help the country in every way so as to industrialize as quickly as possible.

The engineering education given to young engineers must be such that we have real good engineers and not just average ones. In this connection, the most important thing is to have the appropriate number of engineering colleges with proper accommodation, equipment in the laboratories, qualified lecturers and professors. The education which most of us get and the benefits we derive from it depend largely on professors and lecturers. The education that we get depends upon the system of teaching. Due to shortage of space, the classes are crowded and it is not possible for lecturers to give the attention they should give to every student. But, as long as they teach well the fundamental principles of engineering, may be electrical, mechanical, metallurgical, or industrial, the students can further study and make progress. I think we are accustomed to put great stress on the memory of the student who crams the subject although he can answer the questions very well. That is not what is wanted, because if a student answers the question after cramming, he will not do much good when he has to tackle engineering problems in his profession. Our system of examinations requires modification. It is found that the student, instead of really studying and grasping the subject, goes through the question papers for the last few years and then studies some of the things he thinks are likely to be asked.

An important thing which is required in our country is the aptitude test because the student, after Matriculation or after Inter Science, thinks about what he likes to study further, say, Mechanical engineering, electrical engineering, or civil engineering. This selection is the most important thing in his life. In some places in the country such aptitude tests are adopted but not to the same extent as in foreign countries. To pass an examination and get a degree in engineering is not everything. It is said, and correctly so, that a degree will help a person to get a job but it will not help him to hold it. I strongly recommend also that aptitude tests be developed because this will save overcrowding in the colleges and also the number of educated unemployed.

As part of engineering education, a great deal of importance should be given to works visits. Earlier, we did not have many places where the engineering students could go and spend some time to see what they have read in the books. Now, with so many public sector steel plants, and more to follow, engineers will have a better chance to visit the works.

It is very unfortunate in our country that the lecturers and professors are not paid adequately though the whole future of the country depends upon the young men who are receiving their training from them. As a result, brilliant men do not go into the teaching profession. It is either the second or the third grade men, who cannot get a job elsewhere, who go for teaching. The teaching staff should be placed on par with personnel who are actually producing things because teachers play a very important role in producing good engineers.

A tendency which is prevalent amongst engineering graduates is to think that they know everything after passing the examination, and they are not very willing to work with their own hands. They want supervisory jobs, but to supervise one must know how to do the job oneself. It is a common saying in the army that 'to become an officer you have got to be a soldier'. There is another saying in the army that 'there are no bad soldiers but there are bad officers'.

Another important thing is to encourage young engineers. It is sometimes felt that a young engineer does not know anything and unless he has 20 years to 30 years experience, he is not much good. I think that age is no criterion for intelligence and experience, because one man can get an experience in two years which may take five years in the case of another man. Today, with the three steel plants and the increase in steel production, we are up against a serious problem to get experienced men. We should try to take young bright engineers by selecting the right ones without putting too much stress on first or second class. We should put stress on how much of the engineering principles he has absorbed.

I now inaugurate the Bhilai Sub-Centre of the Institution. I wish that this Sub-Centre will do very useful work to help our young engineers, hold seminars, and discussions, and, if necessary, hold classes. This kind of organization in our steel city of Bhilai, which has given the lead to all other steel plants, is very laudable and praiseworthy.'

Shri Kukereja then read the messages of good wishes for the success of the Sub-Centre received from distinguished persons. Shri L. N. Misra then proposed a vote of thanks in the following words: 'Engineers are builders and the world in the last 50 years has built much more than in the last thousand years. The job of the engineer has become predominant. The world is moving so fast that whatever was on top yesterday is becoming outdated. If we recall the speed at which our predecessors moved a decade ago, and decide to move at the same speed, our work will come to a standstill. To keep pace with the world, exchange of ideas is necessary.

Everyone talks of experience and shortage of experienced men. But, there are enough experienced men who feel they have not been properly utilized. The main reason is the common mistake of identifying experience with the number of years spent in industry or with machines. Fundamentally, the number of years has, at times, nothing to do with real experience. For example, I may be doing a job of similar type repeatedly for years, but I have done after 25 years, say, in that job, only one year's experience repeated 25 times. It cannot be equal to 25 years experience.

'The trouble with the school of experience' said Henry Ford 'is that by the time the student graduates, he is too old for any useful work.' I am told, in the U.S.S.R., people on the top are not more than 45 years of age. We in India have to wait for 45 years before we are thought fit to deliver the goods.

India has about 50 years experience in steel plants. Can we use that experience profitably without any adjustment in the high pressure blast furnace operation in Bhilai ? Can we use that experience in the carbon lined, splash cooled blast furnace in Rourkela, the L.D. converters and the one-mile-a-minute or half-mile-a-minute strip mill in Rourkela ? This burden falls on the young engineers now in colleges, and that is why their education is a very primary thing.

Very often, in industry, we talk in terms of stability. When somebody asked Henry Ford why he did not bring stability to his car industry, he replied 'Stability is a dead fish ; it only floats downstream. The only stability in car industry is change and change.' The more experienced we are the more we get stabilized ; the more we refuse to change the more we cannot fit in the pattern of today's fast world. The Institution keeps this motto of adaptability in the forefront. We, in Bhilai, want to bear the brunt of burden of the steel plant through young engineers, called 'junior engineers'. The men with 30 years experience in our steel plant are not many. Such men have to teach the younger engineers and bring home to them the necessity to adapt and to change.

In this direction, the exchange of views and holding of seminars will help a long way. With that in view we have opened this Sub-Centre of the Institution.

In the end, we are thankful to you, Sir, who at the last minute gave us the time to inaugurate this Sub-Centre. Our special thanks are due to the Madhya Pradesh Centre who did everything to form this Centre. We are also thankful to the management of Hindustan Steel, who put this hall at our disposal, and we are thankful to the Bhilai steel project. We are thankful to you all who are present here, who come from distant places, and to the many who have worked behind the scene and are still working to make this whole thing a success.'

A technical session followed the inauguration. A number of technical papers were read and discussed during the session.

At 5.30 p.m. the members and guests were entertained at tea by the Bhilai steelworks.

Opening of a new Sub-Centre at Roorkee

As approved by the Council in their 419th Meeting held in Bangalore on May 10-11, 1961 a Sub-Centre of the Institution was opened at Roorkee on August 24, 1961.

The first meeting of the Sub-Centre was held in the Convocation Hall, University of Roorkee, on August 24, 1961. Shri G. Pande (*M.*), Vice-Chancellor, and Shri S. C. Dikshit (*A.M.*), Reader in Civil Engineering, University of Roorkee, were elected Chairman and Honorary Secretary, respectively. On this occasion, Shri H. P. Sinha (M.), Consulting Engineer, Ministry of Transport, Government of India, delivered a lecture on 'Road and Road Transport'.

Shri Pande then delivered an address in which he explained the role played by Centres and Sub-Centres in carrying out the activities of the Institution in the following words, 'A Sub-Centre is expected to take active interest in the following :

(i) Holding meetings for discussion of matters of technical interest.

(ii) Encouraging preparation of technical papers.

(iii) Encouraging preparation of reports on technical subjects by groups of experts.

(iv) Collection of statistics and data on plans, etc., of interest to engineers.

(v) Maintaining a technical library.

(vi) Maintenance of a high standard of professional etiquette and technical competance amongst its members through publications, meetings, social gatherings, etc.

These are very comprehensive activities for maintaining and developing good traditions for engineers. We are lucky that at this Sub-Centre we have such big organizations as the Roorkee University, the Bengal Engineer Centre, the Central Building Research Institute, the Irrigation Research Institute, and the U.P. Government Workshop. Besides, in the districts of Dehra Dun, Saharanpur, Muzaffarnagar and Bijnaur, there are a number of industries, and more are coming up. Some important public sector enterprises are to be started soon in these areas. Dehra Dun is the headquarters of the Oil and Natural Gas Commission. In the hill districts of Tehri, Chamoli, Pauri Garhwal and Uttar Kashi, big developments are taking place. If, therefore, we conduct our activities efficiently, I have no doubt that there is a great future for this Sub-Centre.

Engineering is no longer a preserve of the civil engineer, as it once was. The Latin metaphor '*Quot Rami Tot Arboris*', meaning 'as many branches so many trees', which refers to the great banyan tree, can be aptly applied to the engineering profession now. The basic concept is of the banyan tree spreading out, fully strong in every branch, many of them even nourished by their independent roots, but the tree itself remains one. Unity with such diversity gives it long life, strength and usefulness. Similarly, all branches of engineering are so complementary to each other today that only by standing together that we, the engineers, will make a strong and useful organization and carve out our rightful place.

The role of technical personnel is widening and the technical tasks are becoming more responsible and onerous. Scientific, technological and engineering advancements in the world have been very rapid during the last 15 years. We, in this country, are also struggling hard to make as rapid an advance as possible. It is a difficult task. With the limited resources of men and materials, the pace of development appears to be bewildering. Yet, when we look at the leeway that has to be made in every sphere of our national activity, all that is happening appears to be not only inveitable but inadequate. In most of these activities, the engineering profession has a most vital part to play.

This is the age of planning, but planning in a democracy is not a simple affair. Every interest has to be satisfied and not only has a pattern to be evolved which, in the ultimate analysis, helps the achievement of the targets, but some resources have to be utilized in activities which may not be essential but have to be provided for due to local or regional considerations.

The report of the Third Five Year Plan gives some interesting figures. The outlay in the public sector in the First Plan was Rs. 1,960 crores and in the Second Plan, Rs. 4,600 crores. In the Third Plan, the contemplated expenditure is of the order of Rs. 7,500 crores. The private sector investment in the First Plan was Rs. 1,800 crores, in the Second Plan, Rs. 3,100 crores, and the expected expenditure in the Third Plan is Rs. 4,100 crores. In terms of targets to be achieved, the national income will go up by 34% during the Third Plan, agriculture by 25%, mining and factory establishments by 82%, and other sectors by 32%. Production of iron ore will increase from 10.7 to 30 million tons; iron and steel from 6 to 10 million tons; coal from 54.6 to 97 million tons; power from 5,700 to 12,700 MW; railways will carry 245 million tons against the present capacity of 154 tons; number of students will increase from 43.5 to 63.9 millions, and engineering degree level intake from 14,000 to 19,000.

The lack of internal and external resources enjoin upon the engineers to be very prudent, economical and resourceful. The delay caused by rules and regulations, many of which are out of tune today, the constant checks which the Finance Department insists upon, cramp the style and the pace of work. However, let us not forget the simple and widely accepted definition of an engineer that 'he is one who can do for a rupee what anyone else can do for two'. This calls for economical designing, thorough planning and efficient execution.

There should be constant attempts at a proper synthesis of the impulsive confidence of youth, mature experience of middle age, and the mellow wisdom of the old. Every technical person should be suitably employed. I think the Institution can bring about such a synthesis of the available engineering talent.

The three main aims of an engineering university should be, (i) to raise the standard of culture of the student by arranging suitable and intensive extra-curricular activities, including games and sports, study of humanities, etc. to enable him to perform his role as a good citizen; (ii) to give him a good grounding in engineering discipline for laying the correct foundation for his profession; and (iii) to make him a specialist, if required, by providing all facilities for specilization and research. In a pool conducted about two years ago in Calcutta and Bombay, 500 parents were asked as to what career out of the eight mentioned would they choose for their sons, provided they have the intelligence and industry to get into any of these and the parents had the means to support them. With slight variation due to local factors, an average voting of 45% was in favour of the engineering profession, 20% for medical and scientific careers, 8% for business, 6% for politics and law, and 4% for the civil services. This shift from the charms of the administrative services to the engineering and scientific careers is significant.

In mentioning the above facts and drawing conclusions, I have no intention of entering into any controversy with regard to the question that is so often discussed in the gatherings of technical men as to how long would they be kept back from the highest administrative positions, especially in situations where the work to be managed is of a highly technical nature. In my opinion, any work that requires a specialized training and experience is technical and anyone who has that training and experience is, for that particular job, a technical man. Acquiring of an engineering degree by itself does not confer an overriding advantage on a person for tackling higher management jobs, even in a predominantly technical sphere, unless he has acquired the necessary experience in management. However, I also firmly believe that a technical man, properly trained, will be able to manage such jobs much better. What is, therefore, required is the association in ever increasing degree of technical men on the management side.

This is the age of specialization in all spheres of work, but more so in the engineering profession. In the Government departments and the Government owned undertakings, the routine work is so heavy that little time is left for keeping pace with the advancement of engineering knowledge, even in one's own particular line. For those engaged in general engineering work, the question of specialization remains a vague desire which is not likely to be fulfilled. Special cells must, therefore, be created in the big organizations for research, design and standardization, and conditions must be made favourable for competent persons to devote to specialized work.

There is a general inclination to choose the less exacting and more spectacular type of work. For example, in a steel plant, the young engineers, when asked for their choice, invariably requested to be put on the operation rather than the maintenance side. With the high degree of automation that designers and manufacturers are introducing in their machinery and equipment, their operation has become easier and the maintenance correspondingly more difficult. There is also the desire to show off by increasing production at the cost of maintenance. These tendencies must be curbed.

The role of consultants should also be organized and consulting firms should be encouraged to specialize in different spheres. It is staggering to realize that the fees paid to foreign consultants in the steel plants is about Rs. 8 crores. Design organizations have, therefore, to be built up. Specific help should be obtained from consulting firms in India before going to foreigners. Apart from the main difficulty of getting experienced designs engineers and research workers, there is also the reluctance of the majority of engineers to take these specialized jobs. I have to mention all these with a view to place before this Sub-Centre the necessity for reorientating our thoughts and inducing the younger generation to take up more research and designs work and understand the real problems of efficient production.

We are in the jet, nuclear and space age. The old values are gradually giving place to new. I would like to impress on engineers that we have unique opportunities to serve the nation through the profession, and this Sub-Centre should be utilized to the maximum extent in forging ahead and contributing the best to the advancement of the nation.

The measure of life is not years but in achievements. Let us work in right earnest for the achievement of our aims and objects and let us be judged by our efforts in implementing them. Let all of us present here wish all success to the Roorkee Sub-Centre, being inaugurated this afternoon.'

FORTHCOMING CONFERENCES

Seminar on Shell Structures, Bengal Engineering College, Howrah, January 23-26, 1962

A Seminar on Shell Structures will be held at the Bengal Engineering College, Howrah, from January 23-26, 1962. The scope of the Seminar will cover design and construction of shell structures.

Further details regarding the Seminar can be had from the Honorary Secretary, Seminar on Shell Structures, Bengal Engineering College, Howrah.

International Conference on Nonlinear Magnetics, Washington, April 17-19, 1963

An International Conference on Nonlinear Magnetics, sponsored jointly by the American Institute of Electrical Engineers and the Institute of Radio Engineers, will be held in Washington, U.S.A., on April 17-19, 1963. The scope of the Conference includes computer memories and logic, magnetic amplifiers and control systems, combinations of saturable magnetic components with semi-conductors, instrumentation and recording.

Papers are invited for presentation at the Conference. Further information regarding the Conference can be had from the General Chairman, International Conference on Nonlinear Magnetics, 1 River Road, 37-502 Schenectady, N.Y., U.S.A.

BOOK ACKNOWLEDGMENTS

1. **Principles of Control System Engineering.** V. C. Toro and S. R. Parker. *McGraw-Hill Book Co., Inc.*, $ 14.50. 686 pages.

This book deals with methods of analysis and design of feedback control systems and describes their interrelationship. It is divided into five parts, each part dealing with the principles of a particular phase of control system engineering, covering the time-domain method, frequency-domain method, root-locus method, and computer techniques. It also includes a basic treatment of self-adaptive control systems.

2. **Analog Computation.** A. S. Jackson. *McGraw-Hill Book Co., Inc.*, $ 13.50. 652 pages.

This book deals with the basic concepts of analogue computation, and presents the analogue computer as a system of near-perfect components, methods of magnitude and time scaling, use of computer to solve linear, non-linear, and partial differential equations, and use of computer as a simulator. It also covers algebraic matrix problems as applicable to analogue computation and operating research. Basic design considerations and limitations of the electronic analogue computer are also included.

3. **An Introduction to Linear Statistical Models., Vol. 1.** F. A. Graybill. *McGraw-Hill Book Co., Inc.*, $ 12.50. 463 pages.

This book is intended to serve as (i) a textbook in experimental statistics, and (ii) reference book in regression, correlation, least squares, experimental design, etc. for the consulting statistician with limited mathematical training. It deals with mathematical treatment of statistical models and five typical models are discussed from the point of view of infinite model theory.

4. **An Introduction to the Properties of Engineering Materials.** K. G. Pascoe. *Blackie & Son Ltd.*, 35s. 295 pages.

This book deals with the interrelationship between the fundamentals governing the properties of materials and between the properties themselves. It covers the principles of physics of the atom and its structure, mechanical testing of metals and the relationship of test results to engineering design, and elementary nuclear physics.

5. **Toughness and Brittleness in Metals.** Published for the Institution of Metallurgists. *Iliffe Books Ltd.*, 27s. 6d. 108 pages.

This book deals with the significance, engineering aspects, effects of environment, and metallurgical aspects of toughness and brittleness in metals.

6. **Work Study for Everybody.** K. Pennathur. Published by the British Institute of Management, India Branch, New Delhi, Rs. 5.00. 130 pages.

This book, intended to be a guide to the subject of work study, deals with basic principles of work study, with particular reference to conditions prevalent in India.

7. **Highway Engineering.** N. K. Vaswani. *Roorkee Publishing House*, Rs. 10.50. 370 pages.

This book is intended to cater for the needs of the engineering degree course students in the subject of highway engineering, and presents the basic principles of the subject.

PUBLICATIONS RECEIVED

The following publications have recently been received from the United States Department of the Interior, Bureau of Reclamation, Denver, Colorado: (a) 'Hungry Horse Dam and Power Plant' : the publication presents a technical record of design and construction of the Hungry Horse multipurpose project for power generation, flood control, and storage for irrigation, river regulation and improvement of navigation in Montana, U.S.A. ; (2) 'Petrographic and Engineering Properties of Loess' : the publication summarizes knowledge of the physical and physico-chemical properties of loess obtained from Bureau of Reclamation experiments and investigations ; (3) 'Moments and Reactions for Rectangular Plates' ; the publications presents a series of tables containing computed data for use in the design of components for structures which can be treated as rectangular plates or slabs.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Shri T. D. Kapadia

Shri T. D. Kapadia, L.C.E., M.I.E., died in February 1961, at the age of 81.

After passing the Licenciate of Civil Engineering Examination of the University of Bombay, Shri Kapadia joined the Public Works Department, Bombay in 1904. In 1906, he started practice as Architect, Civil Engineer and Insurance Loss Adjuster. During his professional career, he was responsible for design and construction of a number of buildings, drainage and sanitary schemes, and valuation of buildings and properties.

Shri Kapadia joined the Institution as Member in 1936.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

FOREIGN QUALIFIED MECHANICAL ENGINEER, with ten years experience in project engineering, chemical plant design, preparation of engineering flow diagrams, plant layout, piping arrangement and piping details, project estimating, writing specifications, materials procurement, and erection, working in a large British company in Calcutta, seeks change in a responsible position. (Office ref. E.S. 98)

YOUNG ELECTRICAL ENGINEER, B.Sc., A.A.I.E.E., passed Section A of the Associate Membership Examination of the Institution of Engineers (India), will appear for Section B examination, candidate for the forthcoming West Bengal Boiler Operation Engineers Examination, having over seven years experience in installation, operation and maintenance of thermal power plant, drawing office, water treatment and control in three large electric supply undertakings, holding responsible position as Shift Engineer, seeks suitable change with bright prospects. (Office ref, E.S. 99)

ANNUAL REPORT OF THE COUNCIL FOR 1960-61*

The Council present to members the Annual Report for the year ended August 31, 1961.

1. Membership

1.1. *Members on the Roll*

The Roll of the Institution on August 31, 1961, stood at 31,797, with members and attached persons and bodies under different grades as below :

Honorary Members	Honorary Life Members	Members	Associate Members	Companions	Graduates	Students	Affiliates	Subscribers	Total
15	2	1,471	6,883	2	995	22,458	14	86	31,926

1.2. *Applications*

The position of applications for membership received and considered during the year under report was as follows :

Number of applications brought forward from the year 1959-60	..	2,658
Fresh applications received during the year	..	8,250
		10,908
Balance at the end of the year awaiting disposal	..	358

1.3. *Year-Book 1959-60*

The first edition of the Year-Book of the Institution, corrected to August 31, 1960 was published in January 1961.

1.4. *Obituary*

The Council regret to record the deaths of the following members during the year:

Members

Vasudeva Bhandari, Datta Laxman Deshpande, Des Raj, Balakrishna Gordhandas Dholakia, Frederick Charles Griffin, Avadh Vehari Gupta, Narhar Sadashiv Joshi, Kashibhai Bhikabhai Patel, Prof. Surendra Kumar Roy, Keky Cooverji Wadia, **Nawab Zain Yar Jung.** Motumal Asudomal Ansari, Mirza Humayun Ali Baig.

Associate Members

P. E. Chichgur, C. Chokalingam, M. V. Mahajan, Narain Chainrai Pamnani, Lallubhai Ambaram Patel, K. Rangaswamy Iyengar, Krovvidi Venkatrathnam, Rebbapragada Virayya, Durgashanker Bhaishanker Pancholi.

Graduate

Arun Parashuram Ganapule

Students

Dilip Singh, N. K. Khulbe, R. Satapathy, Syed Ibrahim.

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* The Annual Report appears here in abridged form. Copies of the unabridged Report can be had on application from the Secretary.

2. Finance and Accounts

2.1. The Statement of Accounts and the Balance Sheet duly audited by the Institution's Auditors for the year ended August 31, 1961, is given in Appendix I of the Annual Report (*not included here*).

2.2. The Statements of Accounts for all the Local Centres duly audited by the auditors appointed by the respective Committees are given in Appendix II of the Annual Report (*not included here*).

2.3. During the year under report a number of donations were received (*details are given in the full Annual Report*).

2.4. *Public Charitable Trust for the Advancement of Engineering Education*

The following members continued to be the Trustees of the Trust: Maj.-Gen. Harkirat Singh, President, and Dr. K. L. Rao, Shri D. P. R. Cassad, Shri Kanwar Sain, and Dr. M. S. Thacker, Past-Presidents.

3. The Council

During the year under report the following Council meetings were held:

1.	Calcutta	.. September 3, 1960
2.	Jaipur	.. November 26, 1960
3.	Bombay	.. February 6, 1961
4.	Bangalore	.. May 10, 1961

4. Standing Committees of the Council

4.1. The Finance Committee of the Council as constituted at the 41st Annual General Meeting was as follows:

The President

Andhra Pradesh
Dildar Husain

Assam
G. C. Goswami

Bengal
K. C. Banerjee

Bihar
P. R. Guha

Bombay
N. N. Purandare

Delhi
S. S. Kumar

Gujarat
U. N. Mahida

Jammu & Kashmir
P. N. Kumra

Kerala
C. S. Padmanabha Aiyar

Madhya Pradesh
S. S. Swaminathan

Madras
K. V. Thadaney

Mysore
R. A. Rajagopal

Nagpur
R. W. Mavlankar

Orissa
P. V. A. Narayanamurthy

Poona

Brig. P. R. Kumar

Punjab

G. C. Khanna

Rajasthan

V. G. Garde

Uttar Pradesh

K. N. Misra

4.2. The Applications Committee of the Council consisted of the following members:

The President

Andhra Pradesh

Guru Pershad
C. Seshavatharam

Assam

K. Barua
M. S. Muthanna (till 18.8.1961)
M. R. Sitaram (from 19.8.1961)

Bengal

B. N. Chaudhuri
H. C. Mukerji

Bihar

S. K. Ghose
D. Mookerjea

Bombay

R. N. Joshi
K. K. Nambiar

Delhi

R. S. Mehta
Maj.-Gen. S. P. Vohra

Gujarat

G. S. Desai
M. M. Patel

Jammu & Kashmir

J. B. Nanda
V. D. Zadoo

Kerala

S. Ramachandra
S. Varadaraja Sarma

Madhya Pradesh

N. D. M. Appa
S. G. Inamdar

Madras

S. L. Narasimhamoorthi
Prof. P. Rajagopal Pillai

Mysore

B. V. Patankar
C. N. Sharma Rao

Nagpur

H. G. Chaoji
A. R. Vazifdar

Orissa

B. Prosad
V. Rama Rao

Poona

G. T. Gokhale
Brig. P. R. Kumar

Punjab

R. N. Chona
S. L. Kumar

Rajasthan

K. N. Bhargava
V. G. Garde

Uttar Pradesh

B. D. Goyal
S. P. Sinha

4.3. The Examinations Committee of the Council consisted of the following members: The President, Sarvashri K. C. Banerjee, H. S. Batlivala, Dildar Husain, Prof. N. S. Govinda Rao, and Prof. S. Rajaraman.

4.4. *General Purposes Committee*

The General Purposes Committee consisted of the following members: The President D. P. R. Cassad, J. Datt, Prof. H. C. Guha, S. B. Joshi, Karnail Singh, S. S. Kumar, N. N. Purandare, Dr. K. L. Rao, and A. R. Venkataraman.

4.5. *Engineering Science and Research Committee*

The Committee consisted of the following members :

K. F. Antia (Convenor), P. R. Ahuja, V. Cadambe, M. Ganapati, D. V. Joglekar, S. B. Joshi, S. S. Kumar: S. R. Mehra, A. R. Narayana Rao, Dr. T. Sen, Maj.-Gen. S. P. Vohra, and Lt.-Gen. Sir Harold Williams.

4.6. *Committee for Advancement of Engineering Education*

The Committee consisted of the following members :

Dr. K. L. Rao (Convenor), Brig. S. K. Bose, Prof. S. P. Chakravarti, G. K. Chandiramani, R. N. Dogra, C. L. Handa, Brig. P. R. Kumar, Dr. S. P. Luthra, N. N. Purandare, Prof. S. Rajaraman Prof. A. C. Roy, and Dr. T. Sen.

5. **Revision of Bye-Laws**

The revised Bye-laws as adopted by the Council at their 416th meeting held at Calcutta on 3rd and 4th September, 1960, were placed before a Special Meeting of the General Body of Corporate Members at Jaipur on 26th November, 1960. The draft Bye-laws were adopted unanimously by the General Body.

Thereafter, the revised Bye-laws were submitted by the President to the Government of India for approval by the appropriate authority. The matter rests at that stage.

6. **Reorganization of Local Centres**

A new Local Centre in Gujarat was established during the year under report. Following Sub-Centres were established during the year : Bhilai, Bhopal, Durgapur, Jammu, Kharagpur, Nagarjunasagar, Ranchi and Roorkee.

7. **The *Journal* and the *Bulletin***

7.1. *The year's publications*

The *Journal* in two Parts was published till May 1961. The publications policy of the Institution was revised effective June 1961, and under the new scheme, the *Journal* was divided into seven separate Divisions as under :

(1) Civil Engineering Division	(to be published six times a year, in September, November, January, March, May and July)
(2) Mechanical Engineering Division	(to be published six times a year, in September, November, January, March, May and July)
(3) Electrical Engineering Division	(to be published six times a year, in October, December, February, April, June and August)
(4) Electronics and Telecommunication Engineering Division	(to be published three times a year, in September, January and May)
(5) Chemical Engineering Division	(to be published three times a year, in October, February and June)

(6) Mining and Metallurgy Division	(to be published three times a year, in November, March and July)
(7) General Engineering Division	(to be published three times a year, in December, April and August)

The *Bulletin* was published every month as before.

7.2. *Technical papers*

The number of technical papers and articles published under the various Sections and Groups in the *Journal* during the year were Civil Section 13, Mechanical Section 13, Electrical Section 20, General Section 9, Public Health Engineering Group 4, Railway Engineering Group 1, Roads and Road Transportation Group 2, Industrial Management and Production Engineering Group 1, Electronics and Telecommunication Engineering Group 4, Chemical Engineering Group 5, and Mining and Metallurgy Group 4; and in the Bulletin 5 articles were published in the same period, making a total of 79. Besides these, 34 discussions on papers were also published.

The number of papers received during the year was 159. Out of these, 95 were approved for publication, and 18 were awaiting the recommendations of the Sectional Chairmen.

7.3. *Hindi Section*

The Hindi Section under the guidance of Shri Brijmohan Lal, Adviser, continued to supplement each Part of the Journal. From June 1961, in accordance with the new publications policy, the Hindi Section is to be issued as a separate volume three times a year in December, April and August. The August 1961 issue of the Hindi Section contained 105 pages. Prior to this, 146 pages of Part 1 and 123 pages of Part 2 were published, making a total of 374 during the year under report.

The standard of original articles has appreciably risen. The number of papers published in Part 1 was 23, that in Part 2 was 26, and that in the August 1961 issue was 13, the total number being 62. Of these original contributions in Hindi were 13, the rest being Hindi translations of English articles made by the Adviser, Hindi Section.

7.4. *Museum of Indigenous Technical Literature*

More books have been added to the Museum during the year. The Museum is under the charge of the Nagpur Centre and works under the guidance of Shri Brijmohan Lal, Adviser, Hindi Section.

8. **Examinations**

8.1. *Results of examinations held in November* 1960 *and May* 1961

The results of the Institution examinations held in November 1959 and May 1960 were as follows :

Studentship Examination

	November 1960	May 1961
No. of candidates appeared	456	609
No. of candidates passed	63	66
Percentage passed	13.8	10.8

Section A

No. of candidates appeared	4,495	4,570
No of candidates passed	692	655
Percentage passed	15.4	14.3

Section B

No. of candidates appeared	804	965
No. of candidates passed	130	145
Percentage passed	16.1	15.0

Section C

No. of candidates appeared	15
No. of candidates passed	14
Percentage passed	93.3

8.2. *Regrouping of subjects in Sections A and B of the Associate Membership Examination*

The draft syllabuses in the proposed new scheme of regrouping the subjects in Sections A and B of the Associate Membership Examination prepared by the Examinations Committee were due to be placed before the September 1961 Meeting of the Council for final adoption and implementation.

9. **Recognition of exempting qualifications**

(a) The following qualifications were recognized as exempting from the Studentship Examination of the Institution :

(1) Overseer Certificate in Civil Engineering of the Gandhidham Civil Engineering Institute, Adipur, Kutch.

(2) Draftsmanship Diploma in Mechanical and Electrical Engineering of the Roorkee University.

(3) Class I Courses of (i) Line, (ii) Radio, and (iii) Telegraph Mechanics of the Corps of Signals, conducted at the School of Signals, Mhow.

(4) L.C.E., L.M.E. and L.E.E. Certificates of the State Council for Engineering and Technical Education, West Bengal.

(5) Diplomas in Civil Engineering, Mechanical Engineering, Electrical Engineering, Electrical Communication Engineering, Metallurgy, Internal Combustion Engineering, Automobile Engineering, Mechanical and Electrical Engineering of the Department of Technical Education, Maharashtra.

(6) L.C.E., L.M.E., L.E.E., L.Min.E. and L.R.E. Diplomas of the Board of Technical Examinations, Mysore.

(7) Diploma in Mining Engineering of the Board of Technical Education, Rajasthan.

(8) Certificate Courses in (i) Civil, (ii) Mechanical, and (iii) Electrical Engineering of the State Council of Technical Education and Training, Orissa.

(9) Draftsman Estimating and Design Class 3, and Mechanists Electrical and Mechanical Class 3, Courses of the College of Military Engineering, Kirkee.

(10) Diplomas in (i) Electrical, and (ii) Mechanical Engineering of the State Board of Technical Education and Training, Uttar Pradesh.

(11) Machine Tool Branch of the Diploma in Mechanical Engineering of the Board of Technical Examinations, Mysore.

(12) Diplomas in (i) Civil, (ii) Mechanical and (iii) Electrical Engineering of the M.P. Board of Technical Education, Bhopal (formerly Board of Technical Examinations, Madhya Pradesh).

(13) Four-year Diploma course in Electrical and Mechanical Technology of the National Institute of Engineering, Hoshiarpur, Punjab.

(b) The following qualifications were recognised as exempting from Sections A and B of the Associate Membership Examination :

(1) M.Tech. Degree in Applied Physics of the Calcutta University.

(2) B.E. Degree in Telecommunication Engineering of the Rajasthan University.

10. Annual General Meeting

The 41st Annual General Meeting was held in Bombay between February 1-7, 1961.

A full account of the 41st Annual Session has been published on pages 9-36 of the Bulletin, vol. 10, no. 7, March 1961.

11. Representation on other bodies

The names of the representatives of the Institution on other bodies are given in Appendix III of the Annual Report (*not included here*).

12. International Conferences

Sixth Plenary Meeting of the World Power Conference, Melbourne, Australia, October 20-26, 1962.

The Sixth Plenary Meeting of the World Power Conference will be held in Melbourne, Australia, between October 20 and 26, 1962. The theme of the Meeting will be 'The Changing Pattern of Power'.

The Institution in its capacity as the Indian National Committee for the World Power Conference has been allotted a quota of four papers. Preparations are being made for the submission of these papers.

Sixth World Petroleum Congress, Frankfurt, German Federal Republic, June 19-26, 1963.

The Sixth World Petroleum Congress will be held in Frankfurt, German Federal Republic, between June 19 and 26, 1963.

The Institution in its capacity as the Indian National Committee for the World Petroleum Congress has been allotted a quota of one paper. Preparations are being made for the submission of this paper. Dr. J. W. Whitaker (*M.*), Chairman, Mining and Metallurgy Group, is the Chairman of the Papers Committee.

13. Paper meetings at Local Centres, visits and excursions

Details are given in Appendix IV of the full Annual Report.

14. The Council wish to thank the many honorary workers for their very valuable service rendered during the year and to record that they are deeply conscious of their contribution. In particular, the Standing Committees of the Council, the Committees of the Local Centres, and Shri Brijmohan Lal, Adviser, Hindi Section, deserve mention. The Council also acknowledge with appreciation the great volume of work conducted by the staff of the Headquarters and the Local Centre offices.

THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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Contemporary World Engineering Projects Series—18

Members are invited to contribute to this Series special articles featuring major engineering projects which they may have visited or with which they may have been associated in any other manner. Articles should be preferably accompanied by photographs and illustrative sketches.

OEEC HALDEN BOILING HEAVY WATER REACTOR PROJECT

General

The OEEC Halden Boiling Heavy Water Reactor Project is organized by the Organization for European Economic Cooperation, Nuclear Energy Agency, at Halden in southern Norway, primarily to provide information on the construction and operation of boiling heavy water type of reactors.

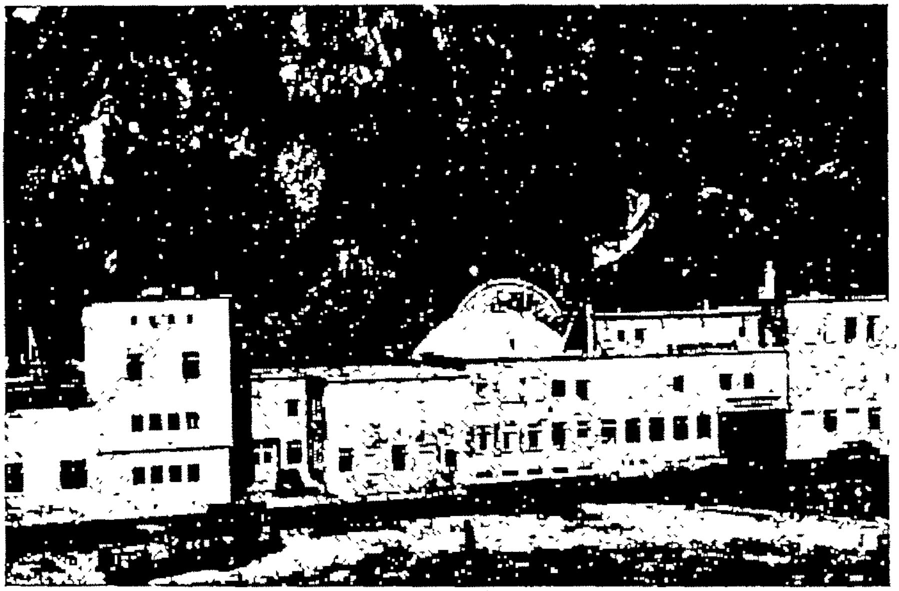

Fig. 1

General view of the OEEC Halden Boiling Heavy Water Reactor building

The reactor plant is situated in an excavation in a rocky hillside to provide containment for any dangerous radioactivity which may be released in the event of an

---

Compiled from publications made available by the courtesy of the Organization for European Economic Cooperation, European Nuclear Energy Agency.

accident. It is located adjacent to a paper pulp factory which is expected to utilize the steam generated in the reactor. Access to the plant is through a tunnel, 60 m. long, sealed by airtight doors which are designed to withstand pressures from possible shock waves.

The reactor core and the moderator coolant of 16 tons of heavy water are contained in a pressure vessel. The moderator is made to boil in the core, and give off its steam to a shell/tube heat exchanger where the latent heat of evaporation is removed by circulation of ordinary water, and the condensate is returned directly to the reactor vessel either by gravity or by passing through a subcooler pump. However, the main purpose of the subcooler circuit is to provide means for controlling the volume of steam in the vessel and the boiling length of the fuel elements. Heavy water is drawn out from the bottom of the reactor vessel, pumped through a cooler, which can also be bypassed if required, and returned to the vessel. Heavy water can be introduced into the vessel either from above the water level or through nozzles at the bottom of the fuel elements.

The primary or heavy water circuit is equipped with a purification device for cleaning the heavy water, and a handling circuit for transfer of heavy water between the storage tank and the reactor.

The heat given out by the heavy water in the primary heat exchanger is transferred to light water which is fed from a water treatment preheater system into a La Mont type controlled circulation system. The resultant mixture of steam and light water flows to a steam drum, from where the steam can be either discharged to atmosphere or fed into the low pressure steam supply to the paper pulp factory. Water separated from steam in the steam drum is mixed with make-up water from the water treatment preheater system and is pumped through the main heat exchanger.

All water, steam and air leaving the reactor containment are monitored before they are discharged, and in the case of its being radioactive, the exit lines are automatically closed. The water can then be held in delay tanks until the radioactivity is reduced to a permissible level for release.

The elements for the first fuel charge consist of natural uranium rods canned in aluminium. With this fuel charge, reactor operation is limited to 150°C. (corresponding to 5 MW at a pressure of 5 atmosphere) in order to limit the corrosion of the aluminium canning. Spike elements are available for increasing the reactivity when required. These consist of 1.5% enriched uranium oxide canned in stainless steel.

The second fuel charge consists of 1.5% enriched uranium canned in zircaloy, and made in the form of tubes, seven of which form an element. The second charge enables the reactor to be brought up to its maximum rating, *i.e.*, 20 MW 30 atmoshpere pressure and 230°C. temperature.

Primary (heavy water) system

Reactor vessel.

The reactor vessel is constructed of boiler steel with corrosion resistant inner surfaces. It consists of a cylindrical shell, 27 cm. in diameter, with four longitudinal welds, an ellipsoidal bottom pressed out of one piece, a flange ring, and a lid. The complete vessel is 47 cm. high. It is provided with two tube connections, one at the bottom for connection to the subcooler pump and drain system, and the other at the top for connection to an internal cooling jacket. There are no radial tube connections to the cylindrical portion, and the complete vessel rests freely on four radial guides on a water-cooled support structure. It can therefore be lifted out after disconnecting the top and bottom tube connections. The total weight of the vessel is of the order of 100 tons.

Fig. 2

Cutaway model of the reactor

The vessel is designed for maximum working pressure and temperature of 40 atmospheres and 250°C. respectively. As it was estimated that the highest brittle/ductile transition temperature of any part of the vessel structure is about 18°C., the vessel is maintained at a minimum temperature of 40°C. during shut down, thus providing adequate margin of safety.

A 130 mm. thick stainless steel fuel bottom guide plate is suspended from the reactor lid. It provides location for each fuel element at the bottom by means of a funnel shaped hole, leaving freedom for axial movement due to thermal expansion. It also incorporates a plenum chamber from which subcooled water can be introduced through nozzles into the bottom of each fuel element assembly inside the shroud.

Three steel plates, 158 mm., 100 mm. and 35 mm. thick, are also suspended from the reactor lid to act as thermal shields to reduce the thermal and nuclear radiation from the core, thereby minimizing the thermal stresses in the reactor lid.

Fig. 3

Reactor vessel during erection

A cooling jacket of 5 mm. thick stainless steel plates is welded to the inside of the tank above the level of heavy water to limit the temperature of the upper part of the reactor tank and flange ring.

Steam circuit with heat exchanger

At room temperature, the level of heavy water in the reactor is slightly above the top of uranium. During operation and under boiling conditions, the flow pattern is so arranged that the upstreaming steam-water mixture around the fuel elements is contained within the fuel element shrouds and is separate from the downstreaming water between the elements. Heavy water enters the shrouds through ports at the bottom and leaves as heavy steam through perforations at the top. This steam is collected in the space above the level of boiling water and is removed from the reactor through 12 tubes and led to a heat exchanger.

The main heat exchanger is of conventional shell/U-tube horizontal pattern. The tubes are rolled and welded into a double tube plate. The small volume between the tube plates is intended for collection of heavy water in case of leakage along the tubes.

The heavy water condensate can be returned to the reactor tank through two possible pipe circuits. The original return path to the reactor tank was through a pipe line from the heat exchanger to the tank, discharging the water approximately 50 cm. below the normal water level in the tank. The driving force was the pressure difference between the reactor and the heat exchanger in addition to a 6 m. gravity head. To avoid the possibility of the condensate in the return pipe to oscillate, and cause nuclear instability in the reactor, the condensate return pipe was connected to the suction side of the subcooler pump, thereby ensuring a controlled removal of condensate from the steam transformer, independent of the reactor power. The two circuits can be used simultaneously or independently of each other.

Subcooler circuit with heat exchanger

To provide experimental facilities for investigating the coupling effect between steam voids and reactivity, external cooling has been introduced into the primary system by providing a subcooler loop. Heavy water at approximately boiling temperature can be taken from the bottom of the reactor to the subcooler through a pump of the glandless, submersible rotary type. The subcooler consists of a simple heat exchanger of the shell and tube type which can dissipate upto 15% of the reactor heat to the main feed water circuit. The subcooled water is then returned to the reactor.

By varying the temperature of the water entering the fuel elements, it is possible to vary the starting point of steam formation along the length of the elements, thus controlling the total steam content and its distribution in the reactor.

Due to nuclear absorption, about 6% of the released energy is developed as heat in the moderator. As the temperature of the moderator is close to its boiling point, this nuclear absorption may result in bulk boiling of the moderator outside the shrouds. Void formation in the moderator, which has an effect on the nuclear stability, can be controlled by the introduction of subcooled water through a pipe line which discharges at the top of the moderator level and close to the circumference of the tank in order to minimize disturbance in the main flow pattern.

Purification and recombination circuits

For purification of the moderator and detection of possible fission products, heavy water is circulated through a purification circuit which branches off from the subcooler circuit. The flow through this circuit is powered by the subcooler pump.

The heavy water is first cooled in an ordinary shell/U-tube heat exchanger to reduce its temperature to approximately 40°C. to protect the ion-exchange resin in the subsequent ion-exchangers. After the cooler, the water passes through a cellulose filter contained in a shielded container in order to remove particulate impurities. From the filter, it flows through a set of ion exchangers, first a cation exchanger and then an anion exchanger shielded in lead. It is then pumped back into the primary system by means of a high pressure reciprocating pump.

Because of the nuclear reactions taking place in the reactor vessel the moderator decompose to a certain extent with the formation of radiolytic gases which may cause explosion. To avoid this danger, these gases are collected in the steam transformer which is at the highest point in the primary circuit, and are led into a recombination circuit. This circuit consists of an electrical preheater which raises the temperature of the gases to oposit 250°C. From the preheater, the gases flow into the recombiner, which is a catalyst chamber filled with aluminium pellets covered by platinum. The process, which is exothermic, is controlled by regulating the rise in temperature across the recombiner unit. The recombined gases are then drawn into the heavy steam line.

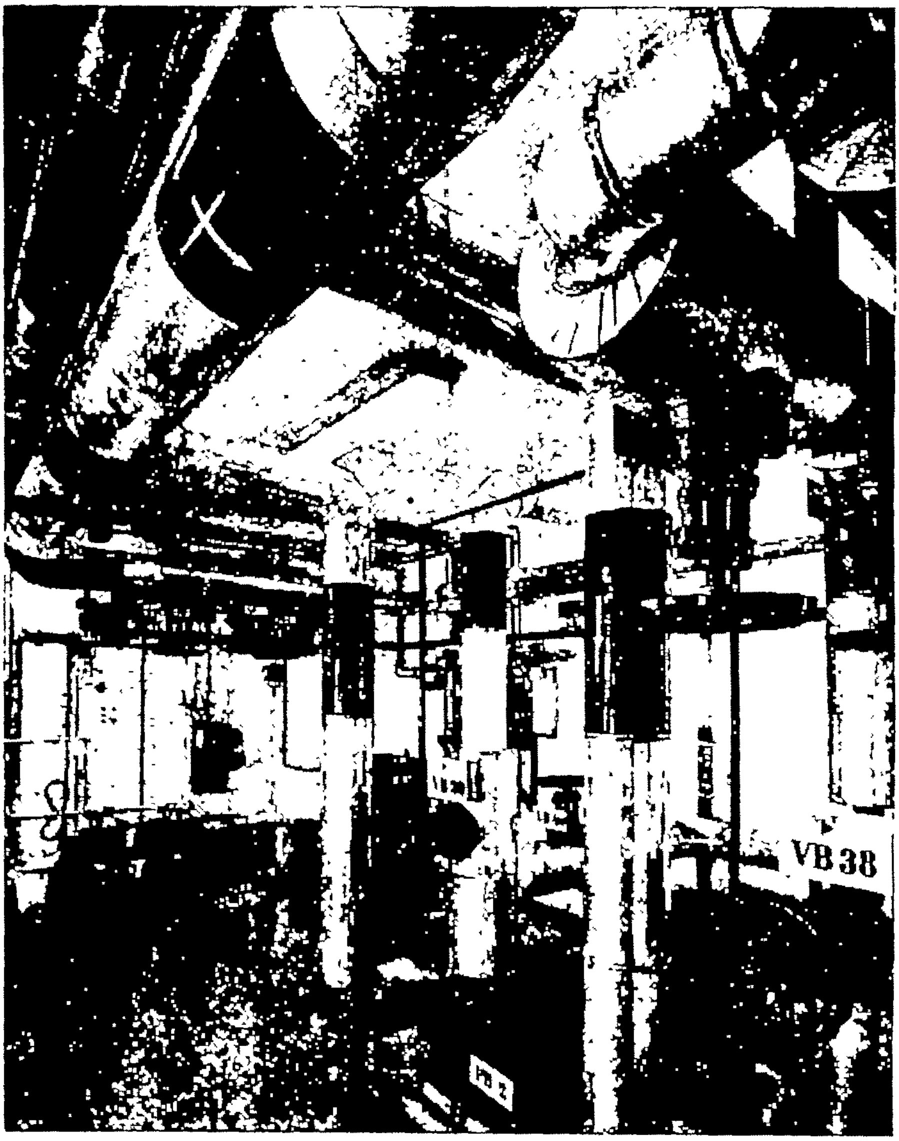

Fig. 4

Pumps for feed water and waste water

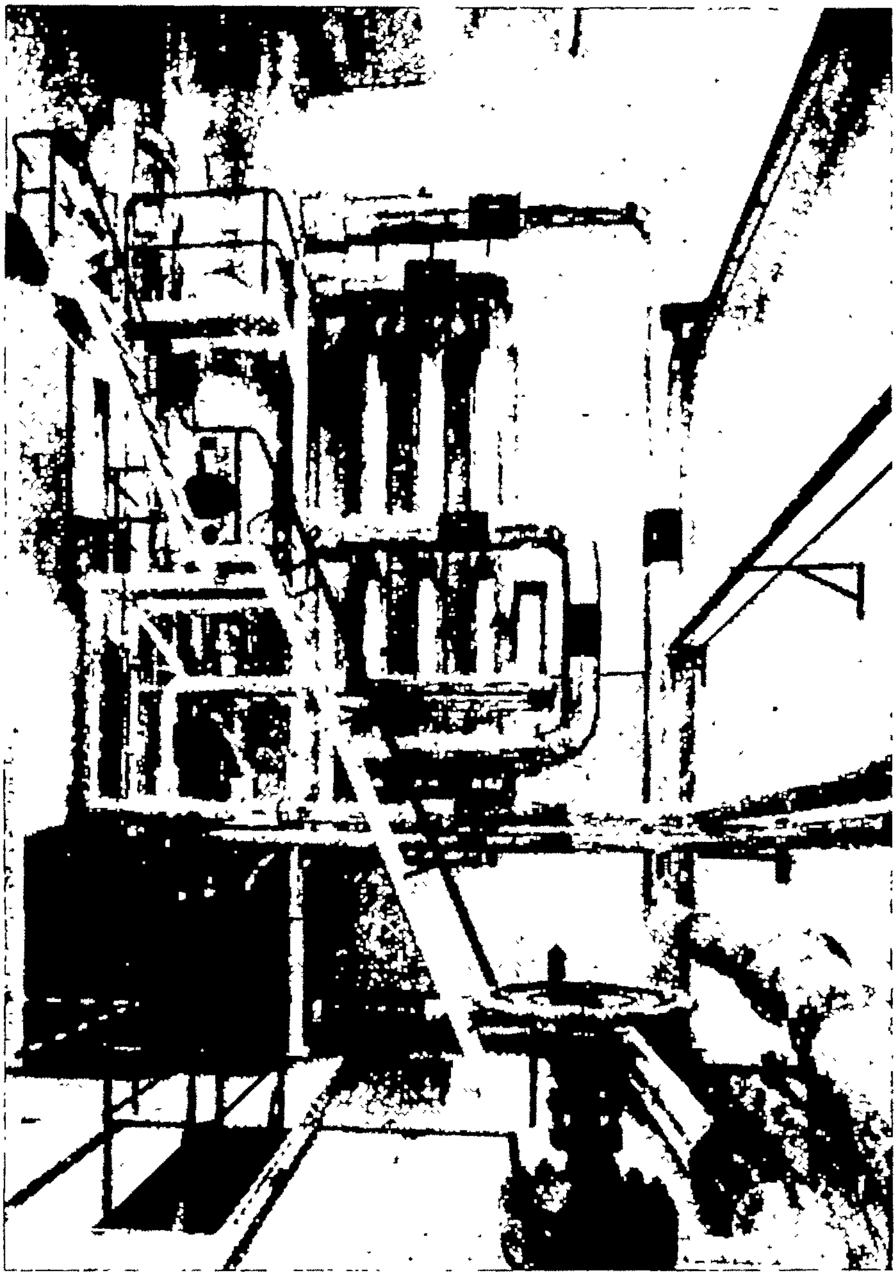

Fig. 5

The steam drum where the steam water is separated from the steam mixture

Recombination is divided into high pressure and low pressure circuits. The former deals with recombination from the heavy steam line and high pressure parts of the system and the latter with the gases which may collect in the storage tank and low pressure parts of the system.

Storage and handling circuit

For storage of the moderator when not in use in the reactor, a welded cylindrical storage vessel is provided. Transfer of heavy water between the storage vessel and the reactor is achieved by means of a centrifugal pump of conventional design.

Secondary (light water) system

Feed water and water treatment circuits

It is necessary to supply feed water continuously to the secondary cooling system, since the resultant secondary steam is released through dummy load valves to the atmosphere. The available raw water is passed through a sand filter before raising its temperature slightly and discharging into feed water and degasser tank. After degassing by injection of steam or hot water, it is pumped with the help of two feed pumps.

The water leaving the subcooler can be fed either to the steam drum or to the feed water tank. Heat equivalent to a power of 1 MW can be removed in the subcooler. If the reactor power is less than 1 MW, with no steam production, the heat removed in the subcooler is discharged to the feed water tank. The heat in excess of what is necessary to preheat the feed water is discharged as steam from the feed water tank to the atmosphere through a constant pressure controller.

Steam circuit

For producing steam, feed water is circulated from the steam drum through secondary side of the main heat exchanger and back to the top of the drum by means of two centrifugal pumps.

Discharge of steam to atmosphere outside the reactor hall is controlled by motor operated valves in the discharge line.

The entire system can be heated electrically with a 300 kW electrical heater attached to the steam drum. Heated light water from the steam drum can be circulated through the subcooler, thereby providing means for heating the reactor before applying nuclear heat.

Auxiliary circuits

Shield cooling circuit

The reactor vessel support is cooled by raw water which is also circulated through pipes cast into the concrete lining of the reactor pit. The heat removed is transferred to feed water through a shell/U-tube heat exchanger.

Purification cooling

The heavy water which is circulated through the purification circuit is cooled to about 40°C., and the heat removed is transferred to feed water as in the shield cooling circuit.

Delay system and waste disposal

If the water used for cooling the reactor hall gets contaminated, it can be held in the delay system until the radioactivity reduces to below dangerous level. The delay system comprises three cylindrical tanks each of capacity 10 $m.^3$, placed outside the reactor hall.

If the delay time is such that the delay tanks are filled, water can be directed back into the waste pit.

Nuclear control system

Ninteen positions are available for control rods in the reactor lattice, of which 10 are occupied during operation with the first fuel charge. Nine of these rods are utilized for course adjustment and one is used as the regulating rod.

The control rods consist of two concentric stainless steel tubes with a cadmium strip sealed between them. Cadmium is wound in a helix over the inner steel tube which has a diameter of 50 mm. Each control rod is raised or lowered by a magnetic coupling between its plunger and a system of electromagnets which form a cylindrical annulus around the pressure thimble.

The reactor can be tripped from the control desk by a switch which cuts off the A.C. supply to the rectifiers for the electromagnets, and the control rods fall into the core under gravity in about 0.85 sec. Another switch enables the rods to be driven into the core at maximum speed. Each rod can be driven individually, and has a corresponding position indicator on the control desk and signal lights to show when it is in the full in or full out position.

Automatic as well as manual control of nuclear power level has been provided. During power operation, the coarse rods are moved only occasionally through manual control to effect gross changes in reactivity. The power level is automatically maintained by operating the regulating rod in a closed loop system in which deviation from a preset nuclear power level is fed back to the regulating rod in the form of a signal, moving the rod in or out of the core.

The instruments are arranged at the control desk in five sections according to their functions ; section 1 for communication equipment, section 2 for counting channels, section 3 accommodates power level and steam pressure indicators, the automatic control, the control rod drive switches and the control rod position indicators, section 4 comprises selector switches for temperature, pressure and flow recorders, and section 5 includes switches for important valves and pumps.

Equipment on the control panels is similarly grouped. The equipment for control and supervision of the power supply is assembled in section 1, the heavy water leakage system is communicated to section 2, lamps for the limit switches on the cadmium rods are mounted in section 3, sections 4 and 5 comprise the recorders, indicators and bypass keys of nuclear instrumentation, sections 6, 7 and 8 are used for process instrumentation and control, section 9 contains monitors of fission product activity, heavy water conductivity and deuterium gas concentration, as well as supervision and control of the heavy water purification system, and section 10 includes health physics monitoring, ventilation and drainage control for the reactor hall and the control

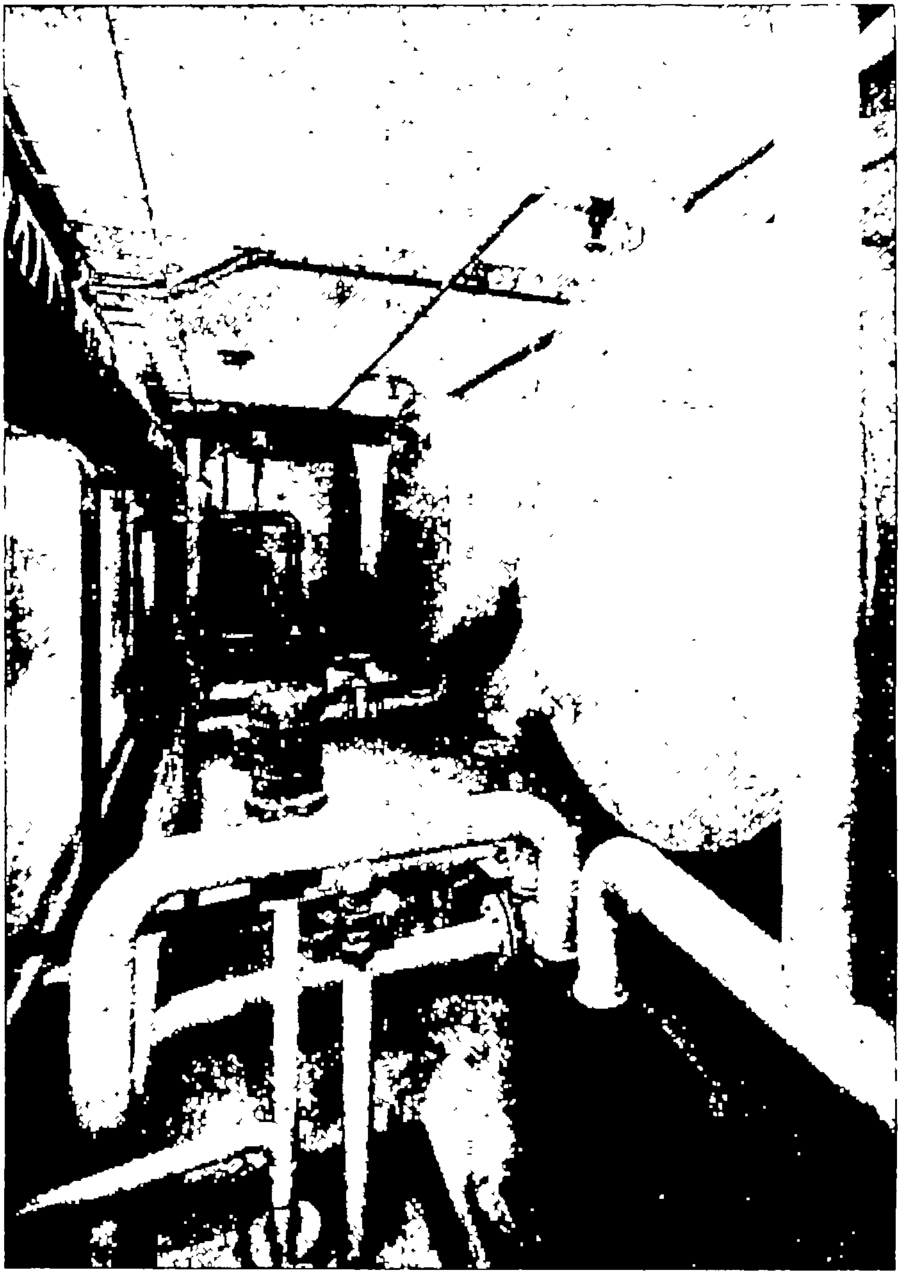

Fig. 6

Delay tanks where all waste water is checked for radioactivity before it is discharged.

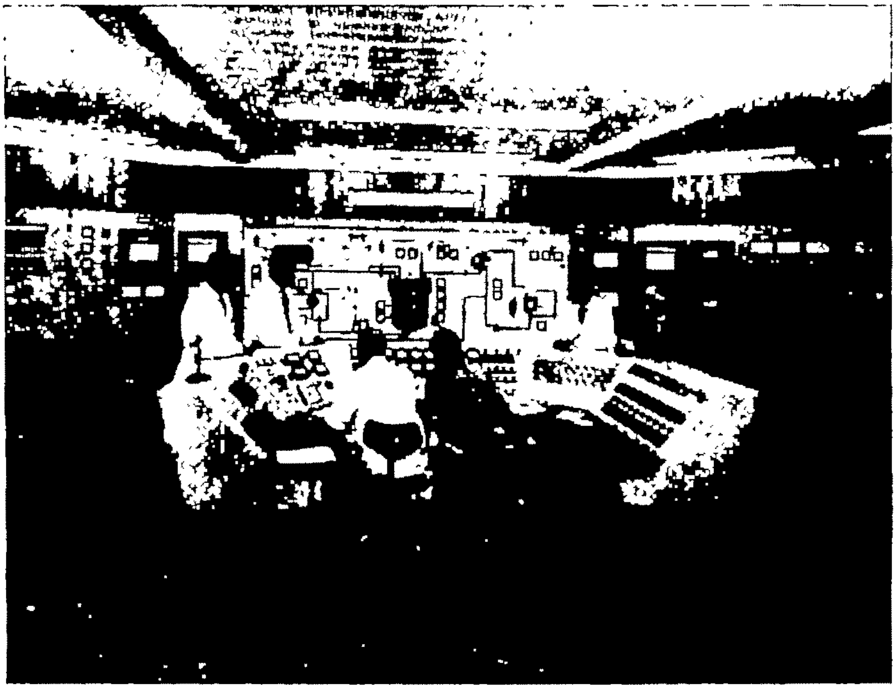

Fig. 7

Control room of the reactor

building. All motorized valves, pumps, compressors and fans can be started and stopped from switches located in the control room, independently of any automatic control of the equipment.

Summaries of Papers Published in the Journal, vol. 42, no. 5, pts. CL 3, ME 3 & ET 2, January 1962

CIVIL ENGINEERING DIVISION

Russian Method of Determination of Bearing Capacity as Compared with Terzaghi's Method

A. L. Chattopadhyay
Non-member

In this paper, an attempt is made to study the Russian system of determination of bearing capacity of soils as against the standard method of Terzaghi. The salient features of the two methods are discussed.

PUBLIC HEALTH ENGINEERING GROUP

Methods of Disposal of Radioactive Wastes

M. Y. Ansari

Associate Member

With the advent of major nuclear power plants and the atomic energy industry, the potential hazards to which man is exposed due to accumulation of radioactive wastes and the ways and means of their disposal have become problems of immense importance. The disposal methods adopted today yet seem to be 'interim arrangements' and better methods can be explored only through intensive research into the nature and effect of these wastes. In the fields of community, municipal and industrial sanitation, the engineer requires to be equipped with thorough knowledge of the environmental hazards that may accrue from these wastes, to make the methods he adopts acceptable from the point of view of safety.

Volatile Acid Control in Sludge Digestion

A. Chandra

Associate Member

Sewage sludge constitutes a rich culture medium which provides abundant food supply either in the original form or modified for supporting micro-organisms. The three well definited stages of slude digestion, *viz*., period of acid production, period of acid regression, and period of intensive objection, are operative at one and the same time, and lead under certain conditions to the establishment of physical, chemical and biological balance so that the digestion process is progressive and is devoid of offensive conditions, the most important aims of the designer. Satisfactory digestion of organic matters under anaerobic conditions depends on two different groups of bacteria, *viz*., (i) saprophytic including many acid forming species, and (ii) methane forming, living harmoniously in the same environment. The paper deals with the second group, and discusses the effects of volatile acid concentration on methane formation, and the control required to maintain an environment most favourable for the growth and activity of methane forming organisms, and stresses on further research in this field.

MECHANICAL ENGINEERING DIVISION

Frictional Behaviour of Machine Tool Guides

S. K. Basu

Associate Member

In this paper, the author has found out experimentally the characteristic relationship between the coefficient of kinetic friction of machine tool guides and the velocity of sliding, under various types of lubricating oils and specific pressures on the guides.

Machine tool guides, which move with the velocity of feed, work in the region of boundary lubrication. This region is characterized by the falling characteristics of the curve of force of friction *vs.* velocity of sliding. This fall is mainly due to the growth and development of a hydrodynamic uplifting force, which increases with the increase in the velocity of sliding. Decrease in the intensity of specific pressure on the guides, increase in the viscosity of lubricating oil, favourable distribution of load on guides—all these factors increase the steepness characteristics of the above curve as the sliding speed increases, and decrease the value of critical velocity, wherefrom starts the regime of liquid friction.

Effect of a Circular Hole on the Bending of a Curved Beam

A. P. Bhattacharyya
Non-member
and
Dr. R. K. Chakrabarti
Associate Member

Many machine frames, links, etc. consist of curved members which are subject to bending or flexural loads. In the design of curved members containing discontinuities, the exact solution of the significant stresses becomes more difficult than in the case of those without any discontinuity. A number of practical problems involving the study of stress distribution in members with discontinuities have been solved by several authors by an analytical approach supplemented by experimental investigations, but the effect of a circular hole on the stress distribution in a curved beam has not been studied fully. This paper presents the results of some phases of investigation carried out in the Applied Mechanics Laboratory, Bengal Engineering College, Howrah, to determine the stress distribution around a centrally placed circular hole in a curved beam under pure bending.

Flank Temperature Distribution of Controlled Contact Cutting Tools

N. C. Sarkar
Non-member
and
A. Bhattacharyya
Associate Member

The flank temperature distribution curves and the values of the peak and average flank temperatures were obtained experimentally using a photoconductive PbS cell in the case of natural and controlled contact tools. In the present investigation, close grained cast iron was machined with a straight tungsten carbide tool for investigating how the tool shape and the distribution of flank temperature influence the growth and development of flank wear.

ELECTRONICS & TELECOMMUNICATION ENGINEERING DIVISION

Effect of Meter Resistance on the Sensitivity of Electronic Wattmeter

S. S. Banerjee
Non-member
and
A. B. Bhattacharyya
Non-member

An electronic wattmeter with triodes or pentodes connected in push-pull and used as squaring elements was designed and the performance was reported in an earlier paper. The indicating meter used in this instrument was connected differentially between the plate load resistance of the valves. As the valves are operated non-linearly, an incremental current flows through the plate resistances of the valves when signal voltage is applied to their grids. The difference in these incremental currents, which is proportional to the power consumed by the load, is shown by the indicating meter. The sensitivity of the wattmeter depends on a number of factors, and in this paper, it is shown how the sensitivity of the instrument varies with meter resistance.

Suppressor-Grid Controlled Voltage Stabilizer

A. K. Chatterjee
Member
K. V. Ramanan
Non-member
and
B. S. Rao
Non-member

The transconductance between the suppressor grid and the plate in a pentode was measured for variation in plate voltage and suppressor bias voltage, and constant transconductance curves were plotted therefrom.

The suppressor grid of the control tube was used for input compensation in a series type degenerative voltage stabilizer employing a single control tube. The operating point was chosen by plotting the dynamic characteristics over the constant transconductance curves so as to give the operating point for maximum control. Improved performance was observed in this type of regulator as compared with those employing other type of compensation.

Hunting in Non-linear Relay Servomechanism

A. K. Chaudhuri
Non-member

In the past few years, great interest has been shown in the study of non-linear control systems. Particularly, efforts are growing towards utilization of the useful effects of non-linearity in automatic feedback control systems. These have given rise to a type of servomechanism called 'relay or on-off'. In conventional methods, the control signal is made proportional to a linear combination of the error, the rate and the integral of the error, and the other signals obtained from the error by linear operations. The method is illustrated with reference to a simple positioning servomechanism whose load is characterized by moment of intertia.

System Planning in Non-Coding Time Division Multiplex

J. Das

Non-member

A comparative study of the effects of bandwidth reduction on (i) signal-to-noise ratio, (ii) crosstalk attenuation, and (iii) side band and harmonic distortion, in the case of pulse amplitude modulation (PAM), pulse slope modulation (PSM), pulse length modulation (PLM) and pulse position modulation (PPM) was made, and it was found that for large bandwidth, PPM gives the best overall performance, but for limited bandwidth, PSM is the most suitable for providing satisfactory communication circuits. The paper mentions how suitable design curves may be evolved from given results to facilitate system planning of a practical time division multiplex circuit.

Design Procedures for Very Wide Band Distributed Amplifiers

S. C. Nath

Non-member

In a distributed amplifier, plate and grid of individual tubes are connected to two transmission lines of suitable points such that their capacitances to ground form, wholly or in part, the shunt capacities of the two respective lines. Apart from a voltage gain between the input and the output, the distributed amplifier is essentially a lumped constant transmission line, which is made up of low pass filter sections in cascade, each having probably a definite loss factor. The amplitude, therefore, cannot respond beyond the cutoff frequency of any of these lines. Further, it can be shown that gain at higher frequencies cannot be improved upon in the same scale as the gain at lower frequencies, simply by increasing the number of tubes in the chain. Actually, by increasing the bandwidth of individual sections of the lines and the number of tubes beyond a certain limit, the overall bandwidth of the amplifier is reduced. Thus, from the standpoint of wide band amplification, a critical understanding of the involved loss factors, which cannot be neglected under conditions of very wide band amplifications, is very essential before one can proceed to a suitable design procedure for a distributed amplifier.

Transistor *RC* Oscillators

V. P. Sinha

Non-member

The use of tapered *RC* networks in transistor phase shift oscillators is discussed in this paper. Tapering reduces the gain requirement, improves frequency stability, and increases the nose selectivity of the circuit. The minimum value of α_{cb} which transistors to be used in phase shift oscillators must have is about 21. Frequency stability of 5 in 10,000 can be easily achieved, and the use of H.T. voltage as low as 6 volts can give an A.C. output of 1 volt or more.

INSTITUTION NOTICES

Revision of National Register of Scientific and Technical Personnel

The Institution would like to invite the attention of its Corporate Members and other qualified engineers to the fact that the Council of Scientific and Industrial Research has undertaken a complete revision of the National Register of Scientific and Technical Personnel since December 1, 1961. The details are mentioned in the sheet attached at the end of this *Bulletin* (the copies distributed to Corporate Members and Graduates only), which also contains a Registration/Revision form.

This Register of Scientific and Technical Personnel is of great national value and of considerable interest to the engineering fraternity. It is hoped that engineers will wholeheartedly cooperate to help compile an up-to-date register. Engineers and technologists holding a degree or diploma are eligible for registration.

The Registration/Revision form, after filling in, should be sent directly to the National Register, C.S.I.R., Rafi Marg, New Delhi, so as to reach there on or before March 31, 1962.

Application forms for Sections A and B of the Associate Membership Examination to be held in May 1962

Application forms for Sections A and B of the Associate Membership Examination to be held in May 1962 are attached to this issue of the *Bulletin*. The programme of the examinations and the detailed instructions are also attached with the application forms, and they may be detached for reference, if so desired. Students are notified that no further application forms will be distributed to them.

All applications accompanied by examinations fees for admission to the May 1962 examination should reach the Head Office before 4 p.m. on Wednesday, March 15, 1962.

British Nuclear Energy Society

The British Nuclear Energy Society has been recently formed in succession to the British Nuclear Energy Conference which was set up in 1956.

The aim of the Society is to provide a forum for discussion of nuclear energy through regular programme of papers, lectures, symposia, etc. The Society will publish a quarterly Journal which will include original articles and important papers published on the subject of nuclear energy from all over the world.

Membership of the Society open to all who have real interest in nuclear energy. Application form and further details can be had from the Secretary, British Nuclear Energy Society, 1-7 Great George Street, London S.W.1.

Draft Indian Standards

The following draft Indian Standard has been issued recently.

Draft Indian Standard Specification for Tubular Steel Poles for Overhead Power Lines—Doc : SMDC 6(113).

This Standard covers the requirements for tubular steel poles of circular cross-sections for overhead power lines.

Members may send their comments on the above draft Standard before February 15, 1962, to Shri J. G. Bodhe (*M.*), 24-26 Dalal Street, Fort Bombay 1, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 2/21 First Line Beach, Madras 1; or 14/69 Civil Lines, Kanpur.

FORTHCOMING CONFERENCES

Conference on the Importance of Electricity in the Control of Aircraft, London, February 26-28, 1962

The Conference on Importance of Electricity in the Control of Aircraft, sponsored jointly by the Institution of Electrical Engineers, London, and the Royal Aeronautical Society, London, will be held in London from February 26-28, 1962. The subjects to be discussed will include:

(i) Degree of reliability of systems and the principles upon which this might be achieved, especially in relation to future aircraft (*e.g.*, autolanding, vertical takeoff, landing and supersonic flight);
(ii) Developments in automatic flight control;
(iii) Developments in airborne navigation systems;
(iv) Developments in engine and fuel controls;
(v) Electrical systems in current aircraft;
(vi) Possible developments and techniques in electrical supply systems;
(vii) Temperature problems associated with supersonic flight and their relationship to the future development of electrical and electronic equipment; and
(viii) Application of new techniques to meet the needs of future aircraft.

Further details regarding the Conference can be had from the Secretary, Institution of Electrical Engineers, Savoy Place, London W.C. 2.

19th Meeting of the International Conference on Large Electric Systems (CIGRE), Paris, May 16-26, 1962

The 19th Meeting of the International Conference on Large Electric Systems (CIGRE) will be held in Paris from May 16-26, 1962. The scope of the Conference includes all technical problems arising in the construction, operation and interconnection of high tension electric power stations and systems.

Further details regarding the Conference can be had from the Vice-President, Conférence Internationale des Grands Réseaux Electriques, 112 Boulevard Haussmann, Paris 8^k.

BOOK ACKNOWLEDGMENTS

1. **Estimating and Costing in Civil Engineering.** B. N. Dutta. Published by the author, Cooks Compound, Motilal Bose Road, Lucknow, Rs. 12.75. 3rd edition. 424 pages.

This third edition of a book dealing with the theory and practice of estimating and costing of civil engineering structures is a revised and enlarged version of the second edition in which a new chapter on the use of metric systems in estimating and costing has been added.

2. **Khanna's Civil Engineer's Ready Reckoner.** G. B. Kanuga. *Khanna Publishers*, Delhi, Rs. 7.50. 279 pages.

This book contains information and practical data for use in the field as well as in design work pertaining to civil engineering works. It covers buildings, reinforced concrete construction, roads, bridges, water supply and sanitary engineering works, irrigation, hydraulics, estimating and electrification methods.

3. **Air Cooled Motor Engines.** J. Mackerle. *Cleaver-Hume Press Ltd.*, 55s. 476 pages.

This book dealing with the theory and design of air cooled engines is intended to serve as a reference book on these engines for cars. It is divided into two parts, the first part dealing with the theoretical aspects of heat transfer and control and utilization of waste heat, and the second part covers design details of individual parts of the engine.

4. **Electric Lighting.** C. E. Gimson. *Cleaver-Hume Press Ltd.*, 15s. 2nd edition. 224 pages.

This second edition of a book intended to serve as a preliminary handbook for lighting contractors, electricians, architects and builders includes minor amendments to the text in the first edition to include recent developments in the field of electric lighting.

5. **Electrical Circuit Analysis.** K. Stephen. *Cleaver-Hume Press Ltd.*, 30s. 259 pages.

This book is intended to serve as a text-book in the subject of electrical circuit analysis for electrical engineering degree courses, and deals with basic laws, theorems and techniques of circuit analysis. It also includes an introduction to the more specialized techniques of circuit analysis required at a post-graduate level.

PUBLICATIONS RECEIVED

The following publications have been recently received from the National Buildings Organization: (1) 'Standard Designs of Timber Doors and Windows for Residential Buildings'; the publication presents standard designs and details of timber doors and windows for residential buildings with a view to enable their economic production on mass scale. (2) 'Manual on Brickmaking': the publication presents suggestions for preparation of soil for making good bricks, methods of making good bricks, and description of the machinery commonly used for brickmaking.

A publication entitled 'Building Lime' has been received from the Lime Manufacturers Association of India, Delhi. The publication deals with the qualities and characteristics of lime as building material, storage and slaking, preparation and properties of lime mortars and plasters, and uses of lime in the building industry.

The following publications have been received from the Central Water and Power Research Station, Poona: (1) 'Training of Fulta James and Mary Reach of Hooghly': the publication gives a resume of model studies carried out at the Central Water and Power Research Station Poona, to evolve an optimum solution for the improvement of the Fulta James and Mary Reach on Hooghly River with a view.to investigate the measures for improving the navigability of the river at these points. (2) 'Balari Bar and Regime of Hooghly Estuary': the publication deals with the sand transport characteristics of the Hooghly River and estuary and its effect on the bars in the estuary below Diamond Harbour.

OBITUARY

The sympathy of the Institution is extended to the relative of those whose passing is recorded here.

Shri B. B. Basu

Shri B. B. Basu, M.A., Membership Officer at the Headquarters of the Institution, died on October, 24 1961, of coronary thrombosis after a brief illness.

Shri Basu was born in 1913. He received his education from the Rammohan Ray Seminary, Patna, and graduated from the Patna College in 1933. He took his M.A. degree in Economics from the Patna University in 1935.

Shri Basu was employed under the Government of Bihar as an Inspector of Cooperative Societies from 1935 to 1941. After working in other capacities, he was appointed Assistant Secretary in the Kalyanpur Lime Works where he remained till 1951.

In 1954, he joined the Headquarters Office of the Institution as Superintendent (Membership). He was promoted to Membership Officer in 1959. Shri Basu rendered outstanding service to the Institution and was responsible for a great deal of reorganization in the Membership Department to expedite the processes of disposal of applications. He conducted his work with dignity and expedition which received wide appreciation.

He left behind his wife and seven minor children, and in November 1961 the Council sanctioned a pension for the family for a period of five years.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

EXPERIENCED CHARTERED ENGINEER, B.E. (Civil), M.I.Struct.E., M.I.E., age 50 years, with extensive experience of over 27 years in contractors' firms, municipality, Military Engineering Service, and P.W.D., is available for full/part time service on reasonable terms for construction or office work including structural designs. (Office ref. E.S. 100).

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

May 1962 Examinations

Programme

Days	S.T. 10.00 to 1.00	S.T. 2.00 to 5.00
	Studentship Examination	
Monday, May 7, 1962	English	Mathematics I
Tuesday, May 8, 1962	Mathematics II	Physics
Wednesday, May 9, 1962	Chemistry	
	Associate Membership Examination—Section A	
Monday, May 7, 1962	Mathematics I	Mathematics II
Tuesday, May 8, 1962	Applied Mechanics	Principles and Applications of Heat, Light and Sound
Wednesday, May 9, 1962	Principles and Applications of Electricity	Theory of Structures and Strength of Materials Theory of Machines Elementary Electrical Engineering Applied Chemistry Physical Chemistry and Organic or Inorganic Chemistry
	Associate Membership Examination—Section B	
Monday, May 7, 1962	Engineering Materials	Engineering Drawing I
Tuesday, May 8, 1962	Engineering Drawing II (from 10.00 a.m. to 1.00 p.m. and 1.30 p.m. to 4.00 p.m.)	
Wednesday, May 9, 1962	Theory and Design of Structures Diffusional Processes. Evaporation and Distillation Chemical Works Organization and Management	Electrical Engineering General Geology Fuels and Combustion
Thursday, May 10, 1962	Irrigation Water Supply and Sanitary Engineering Hydro-Electricity Agricultural Engineering Machine Design Mining Metallurgy Mechanics of Fluids	Thermodynamics and Heat Engines Metallurgy Transport and Storage of Materials Principles of Heat Transmission and Furnaces Soil Mechanics and Foundation Engineering
Friday, May 11, 1962	Workshop Technology Engineering Chemistry Electrical Installations Electrical Measurements Electric Traction Ultra-High Frequency Technique Including Radar and Centimeter-Waves Electro-Chemistry Industrial Stoichiometry	Building Construction Stability and Resistance of Ships Gas Engineering Principles of Mining Metrology and Machine Tools Electricity Supply Instruments and Automatic Control in Chemical Industry Chemical Works Design and Construction Size Reduction, Mixing and Separation
Saturday, May 12, 1962	Hydraulics and Hydraulic Machinery Roads Town Planning Harbours and Docks Architecture Line Communication Railways Power Generation and Distribution in Chemical Works	Electrical Machinery Geodesy Radio Communication Principles of Heat Transmission, Heat Transfer Equipment, and Refrigeration Materials and Mechanical Construction of Chemical Plants
Monday, May 14, 1962	Industrial Engineering and Management	Refrigeration and Air-Conditioning Aeronautics

Form 303 (rev. 4)

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

May 1962 Examinations

General information and instructions to candidates

(Approved by the Examinations Committee, 51st Meeting, Resolution 21, 30th December, 1958)

(Revised by the Examinations Committee, 57th Meeting, Resolution 19, 27th-29th June, 1961 ; and 58th Meeting, Resloution 10, 13th and 14th October, 1961.

(1) The next Studentship and Associate Membership (Sections A and B) Examinations will be held from Monday, May 7, 1962 to Monday, May 14, 1962, both days inclusive. The application forms for the Associate Membership (Sections A and B) Examination and the programme of examinations are attached to this *Bulletin*.

(2) **All applications accompanied by examination fees for admission to the May 1962 examinations should reach the Head Office before 4 p.m. on Thursday, March 15, 1962.** Examination fees once paid are neither refundable nor transferable to a subsequent examination or to any other account. Receipt of examination forms will not be acknowledged by the Head Office, unless accompanied by a self-addressed post-card.

(3) **Examination fees should be preferably deposited at the State Bank of India in the candidates' locality. Attention of the candidates is specially drawn to item 6 in Form 304 (rev. 8) and item 7 in Form 305 (rev. 7) in this regard. The instructions for making such payment are given in card A (attached herewith) and on its reverse. Other modes of payment may be used only if this is not possible. Payment of examination fees by cheque will not be accepted.**

(4) No application for a change of examination centre will be entertained after 4 p.m. on Thursday March 15, 1962.

(5) Students who are in arrears of subscription will not be admitted to the examinations.

(6) **The Institution reserves the right to reject incomplete or illegible applications without any reference to the candidate.**

(7) No Student will be permitted to appear in the Section B examination unless he has fully passed the Section A examination or secured exemption therefrom. A candidate for the Section B examination should therefore mention the year in which he passed the Section A examination.

(8) Students appearing for the Section B examination under the revised rules 11.2.1 to 11.2.9 of the rules of examinations (see 'Rules and Syllabuses of Studentship and Associate Membership Examinations') should clearly state in the application form the name of the Local Centre to which they are attached.

(9) A candidate who has already passed the Section A and B examinations or is exempted therefrom will be permitted to appear in any paper or papers of Section A and/or Section B on payment of an examination fee of Rs. 30.00 per paper. The details of passing the Section A and B examinations or of exemption therefrom should be clearly stated in the examination form, with the grade of membership.

(10) The paper in 'Engineering Drawing II' is of 5½ hours' duration, with a half-hour recess between. Candidates will not, however, be permitted to leave the examination hall.

(11) Section B candidates should specially note to write down on the cover of their answer-books of the paper in 'Engineering Drawing II' the names of their particular sections, *viz.*, structural steelwork or reinforced concrete or machines or electrical or chemical plant.

(12) **Candidates are not permitted to use handbook(s) for the paper in 'Engineering Drawing II'. They may however use steel tables of the Dorman-Long type.**

(13) Candidates detected using unfair means in the examination hall will be expelled from the Institution and will not be readmitted to the Institution at any future time.

(14) Candidates reappearing in subject(s) in which they have already secured exemption(s), will have their paper(s) cancelled. The previous exemption(s) will stand.

(15) It is sometimes found that candidates do not enter their Studentship Number/Studentship Application Reference Number, Roll Number, or other necessary particulars on the answer-books. Such answer-books will be rejected and no attempt will be made to locate the candidates. Candidates should therefore take particular care to write down these particulars on the answer-books correctly.

(16) **The results of the May 1962 examinations will be declared before the last day of July 1962.**

(17) Applications for revaluation of answer-books will not be entertained.

(18) After the declaration of results, the marks of each examination will be communicated to candidates on application and on advance payment of Rs. 5.00.

(19) **The Institution reserves the right to cancel the result of any candidate without assigning reasons, in which case, the marks will not be supplied.**

(20) In any future correspondence in regard to the May 1962 examinations, candidates should always mention the Section of the Associate Membership Examination in which they appeared and their centre of examination in May 1962.

THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. SESHADRI, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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Contemporary World Engineering Projects Series—19

Members are invited to contribute to this Series special articles featuring major engineering projects which they may have visited or with which they may have been associated in any other manner. Articles should be preferably accompanied by photographs and illustrative sketches.

DAVIS DAM, ARIZONA, U.S.A.*

General

Davis Dam is located in the Pyramid Canyon on the Colorado River in Arizona, U.S.A.; and is one of the series of dams built between the Grand Canyon and the point where the Colorado River flows into Mexico. It provides a storage reservoir downstream from the Hoover Dam. Regulation of water in this storage pool enables close coordination of power generated at the Hoover Dam with other power sources.

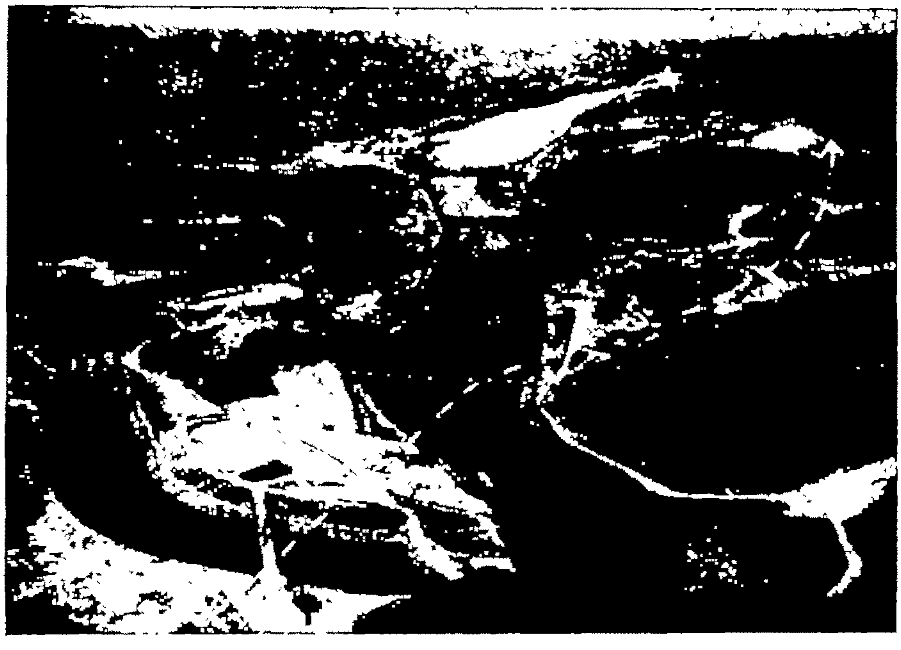

Fig. 1

General view of the Davis Dam site; the dashed line shows the course of the buried channel which crosses the dam (dotted line)

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* Compiled from publications made available by the courtesy of the United States Department of the Interior, Bureau of Reclamation.

Description

Davis Dam is an earth and rockfill dam, 1,600 ft. long, rising about 140 ft. above the river bed. The reservoir formed by the dam covers an area of about 28,500 acres. At the normal high water level, which is the same as the operating tailwater level at the Hoover Dam, the reservoir contains 1,820,000 acre ft. of water of which 1,600,000 acre ft. is active storage, A $\frac{3}{4}$-mile long channel excavated around the left abutment of the dam serves as forebay channel for the spillway, outlet works and power plant. It was used to divert water during the construction of the earth embankment.

The power plant intake structure, located at the right side of the forebay channel, is a mass concrete gravity dam, more than 500 ft. long and ranging in height from 135 to 163 ft. above the foundation rock. The power plant has a semi-outdoor type concrete structure housing five 62,200 h.p. turbines coupled to 45,000 kVA alternators.

The spillway and outlet structure across the downstream end of the forebay channel is a concrete gravity structure about 355 ft. in length. It consists of a central overflow spillway section of 273,000 cusec. capacity, flanked by abutment sections, each containing a radial gate outlet with total capacity of 43,000 cusec.

Geology of the dam site

The foundation area of the dam consists of recent river channel and terrace deposits overlying a gneissic granite bedrock which has been intruded by large rhyolite porphyry dikes and smaller basic dikes. The alluvial deposits which make up the overburden are chiefly silt, sand and gravel in the present river channel, and in a now buried channel which crosses the present channel from east to west just below the dam axis (Fig. 1). Beneath these sediments, and in places protruding through them, is the principal foundation rock which is a badly fractured and faulted porphyritic granite gneiss. It is coarse grained showing a crudely laminated or banded structure obscured at many places by severe crushing and general weathering.

Within the foundation areas of the structures appurtenant to the dam are local areas of very hard and sound gneiss. However, the rock surrounding these hard areas is thoroughly fractured and shattered and includes materials that crumble to fragments under a light hammer blow. Along most of the fractures where movement has occurred, red clay is present, which is developed by mechanical disintegration induced by rock movements and subsequent alterations and chemical decomposition. Movement associated with faulting is evident throughout the foundation rock, and gouge varies in thickness and character from thin films of clay to 20 to 30 ft. thick zones containing severely crushed gneiss and seams of almost pure clay, 12 to 24 in. thick. Three major zones of weakness exist in the gneissic foundation rock in the areas where fault zones cross the power plant and spillway foundations.

A dike of rhyolite porphyry crosses the spillway foundation, but is considered of secondary importance. It is an intrusive mass of later origin than the gneissic country rock, but its structural condition was found favourable. It is intensely fractured and contains many zones of alteration and structural weakness. Discontinuous bands of bentonite clay occur along portions of the contact of the rhyolite with the gneiss. This bentonitic clay is in lenticular bodies of irregular form that range from paper thinness to as much as 24 in. The narrower widths are more common and continuous than the wider intervals. Several small dike-like masses of a dark green basic rock also occur in the foundation area, but these are of minor importance.

Grouting

(*i*) *Design*

The original plan for the foundation treatment divided the grouting treatment into three major categories.

(a) C-zone grouting : this comprised blanket grouting intended to consolidate the rock and permit line drilling for excavation adjacent to all concrete structures, thus reducing the quantity of excavation and subsequent excess concrete required because of overbreak.

(b) B-zone grouting : this provided that the rock foundations for the intake structure, power plant, and spillway and outlet structures be consolidated to depth of about 30 ft. Grouting holes were shown on the drawings at spacings of 20 ft. but provision was made to reduce the distance to 5 ft., if necessary.

(c) A-line grouting : This was designed to establish cutoffs or curtain lines of grout holes in both abutments of the earth dam, and extending from the left abutment of the earth dam to the intake structure, under the intake structure, under the spillway and outlet works, under the gravity wall, and for a distance of about 400 ft upstream from the gravity wall in the berm of the left forebay channel slope. The specifications called for maximum depth of holes to be 260 ft., with a contemplated average depth of 160 ft. Spacing of holes was such as to permit drilling to 5 ft. centers if foundation conditions as disclosed by later drilling and grouting demanded such close spacing. A-line holds under the concrete structures were drilled and grouted from the galleries after the concrete had been placed.

(*ii*) *Construction*

Two methods of injecting grout into the foundation rock were used : (a) nipple grouting, in which the supply is connected to the pipe at the top of the hole, and (b) packer grouting, in which a supply pipe with a packer of expansible material is attached to the end and lowered into the hole to the top of the section to be grouted. The former method was used for shallow and low pressure grouting, while the latter method was employed for grouting at greater depths and higher pressures. When using the packer method, the bottom section of a hole was grouted first, and then it was grouted upward successively by raising the packer to the top of the next higher section to be grouted.

(*iii*) *Equipment for drilling and grouting*

Diamond drills were used for drilling of all grout holes except a number of C-zone holes which were drilled with wagon drills to a depth of 10 ft. The drill machines used were mainly air-driven with speed ratios of 200, 300, 400, and 500 revolutions per in. of forward movement.

Phug bits, $1\frac{3}{8}$ in. diameter, set with congo diamonds were used for drilling the grout holes. Cutting faces of these bits were concave, with two waterways located at different distances from the center of the bit. Similar bits set with bortz diamonds were tried but the cost of drilling was found to be higher than with congo diamonds. Plug bits with small replaceable centre pilot bits were also tried but were abandoned as they were found to be costlier and less satisfactory than the conventional plug bits.

The grout mixer, agitator and pump were assembled on a skid mounted platform, thus making a convenient portable unit. Grout was pumped by air-driven side pot type duplex pumps.

Each grout mixer had a capacity of approximately 20 c.ft. and was powered by air motors. After the grout was mixed, it was discharged into an agitator sump equipped with a stirring blade powered by an air motor to prevent settlement.

Design of earth dam

In the final plan, the dam was visualized as a thin core earth and rock embankment composed predominately of materials excavated from the diversion and forebay channel, and from foundations of the spillway, outlet and power plant structures. This thin core dam was to be proportioned for structural stability without extending a cutoff through the thick layer of silt, sand and gravel overlying bedrock in the river channel.

Preliminary designs provided for a complete cutoff extending from the impervious embankment down to underlying bedrock. From design studies, a backfilled trench appeared to be the most desirable type of cutoff. Other types considered included a concrete wall placed by caissons and a steel sheet piling wall. The concrete wall was estimated to be the most expensive of the three; and the sheet piling, although less costly than the concrete wall, was rejected on the basis of an electrical analogy study which indicated that it would be relatively ineffective in reducing seepage.

Three arguments were advanced, based on the suspected character of the foundation materials, to justify the costruction of a cutoff trench. These were : (i) the water lost by seepage might result in an appreciable loss in power revenue, (ii) the upper 60 ft. of the foundation might require removal to prevent excessive settlement, and (iii) permeable layers might allow piping at the downstream toe. An investigation was, therefore, carried out to study these arguments, and the following results were achieved.

(*i*) *Water loss*

The test results indicated the permeability coefficient of the foundation to be 15,000 to 20,000 ft. per year. The higher value gave a total water loss of only 7 cusec., and it was expected to decrease as a silt blanket formed in the reservoir. The revenue expected to be obtained from this quantity of water was not likely to balance the cost of providing a complete cutoff.

(*ii*) *Settlement*

A study of Denison samples of the overburden, obtained to investigate the possibility of differential settlement in the foundation, showed that no materials were present that would be subject to excessive consolidation.

(*iii*) *Piping*

Another argument favouring a cutoff trench was that it would intercept any layer of permeable material near the surface which might transmit reservoir pressures to the downstream toe and cause piping. Theoretical studies showed that exit gradients of piping intensity might be reduced by an up stream clay blanket and/or they might be dissipated in the downstream section if an appropriate gradation of permeable materials could be secured.

Since an upstream clay blanket and a downstream inverted filter could be provided at little extra cost, both were incorporated in the design. In an ideal situation, these features ensure structural stability of the dam. However, in view of the inherent limitations in interpreting the results of field foundation investigations, and as an added safety factor, a cutoff trench about 60 ft. deep was provided to minimize differential settlement and to intercept premeable surface layers.

A concrete cutoff wall was placed in those sections of the cutoff trench which were excavated in rock to increase the percolation distance in contact zones where compaction in the earth fill may be submarginal.

A grout curtain extends below the cutoff wall footing on the abutments. On its left side, the grout curtain for the dam is extended to tie in with the grout curtains of the forebay structures.

Design of spillway and outlet works

The spillway structure was designed for a capacity of 240,000 cusec. Subsequent reshaping of the spillway crest improved the capacity to 273,000 cusec. To permit withdrawal of large discharges to the lowest practicable level, a spillway with three rectangular regulating gates were provided. These gates, in combination with two radial outlet gates, satisfied all the desired flow conditions.

Except for the manner in which it ties into adjoining structures, the spillway and outlet structure (Fig. 2) is symmetrical, the central portion consisting of an ogee shaped overflow concrete dam and the flanking sections taking the shape of a conventional triangular non-overflow gravity concrete dam with chambers and passageways for raidal gate outlet installations. The spillway and the outlets terminate in a common stilling basin, 170 ft. long and 246 ft. wide, which was designed to produce a hydraulic jump for flow up to 175,000 cusec. Model tests indicated that the action will be increasingly less satisfactory at higher discharges, until for flow approaching 300,000 cusec. 'sweep out' of the jump pool will occur.

Design of intake structure

Based on reservoir operation studies, the power capability of the dam was established as 225 MW. To provide maximum flexibility in operation, together with a proper load-capacity factor, the power plant was selected and designed on the basis of five main generating units rated at 45 MW each. A turbine capacity of 62,200 h.p. operating at full gate opening under the rated net effective head of 120 ft. was estimated to match the rating of the generators. The 22 ft. diameter penstocks conveying water from the forebay to the turbines were selected on the basis of established acceptable velocities and hydraulic losses, and to match the turbine scroll case inlet.

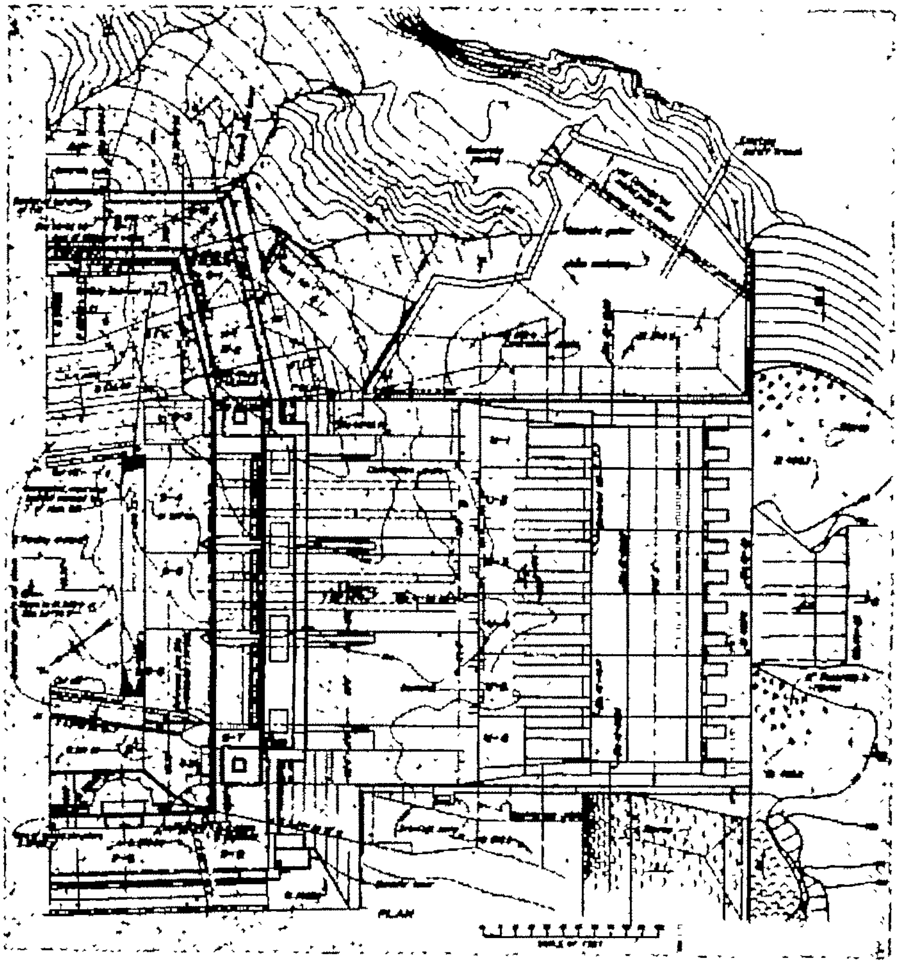

Fig. 2(a)

Spillway and outlet works

Incorporated in the forebay intake structure are the individual entrance openings and trashracks for the penstocks. These openings were designed to produce an acceleration of water similar to that of a jet issuing from a sharp-edged orifice. The concrete surfaces of the entrance are formed to the curvature of a jet having its *vena contracta* equal to the diameter of the penstock. This type of entrance design was deemed essential in reducing to a minimum the hydraulic losses caused by turbulence, and in minimizing the formation of hydraulic rollers and eddies with their inherent cavitation.

The intake structure was constructed as nine separate blocks, the intervening contraction joints of which were keyed and later grouted to form a continuous monolith.

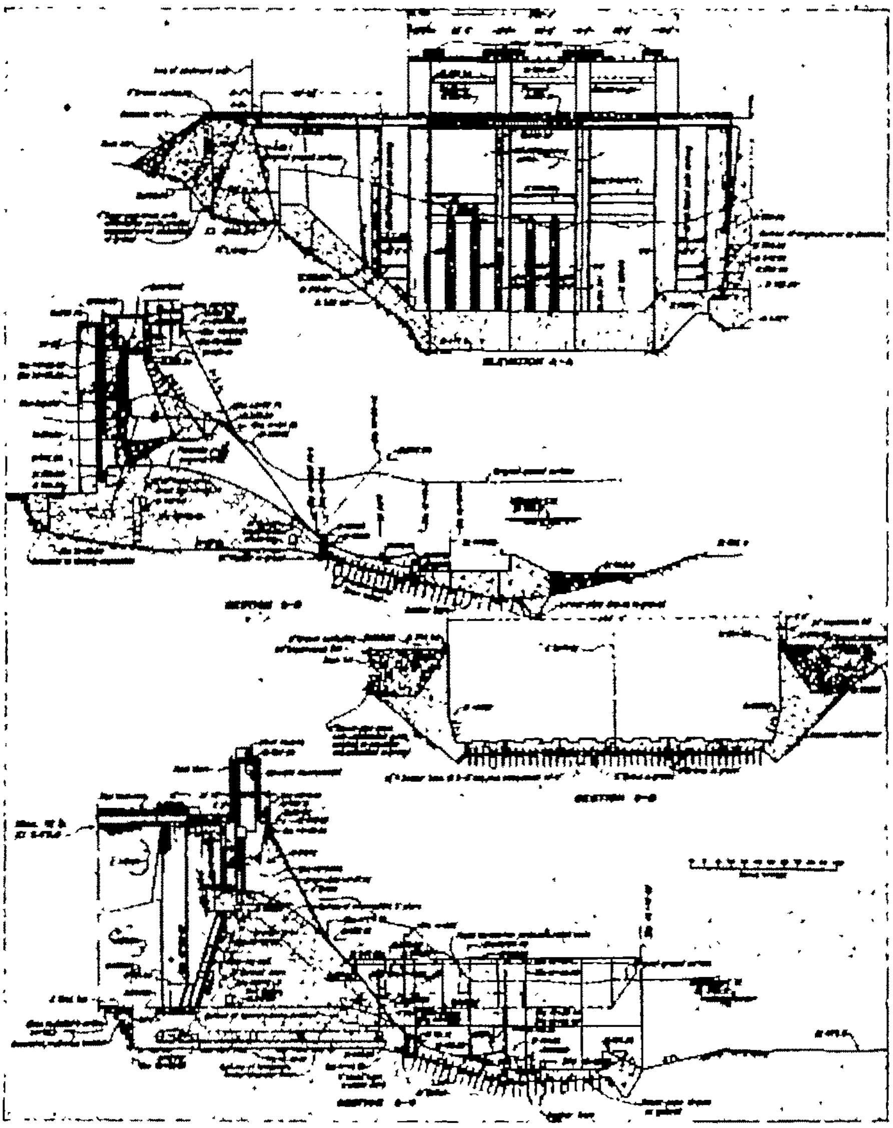

Fig. 2(b)
Spillway and outlet works

The cross-section of the intake structure is triangular. It was later modified by the additions of a crest roadway and a transformer deck along the toe.

Five penstock passages are formed through the intake structure. At the entrance, the passages are rectangular, and transitions formed in the concrete mass blend these entrances into 22 ft. diameter pipes which are embedded in the downstream portion of the structure.

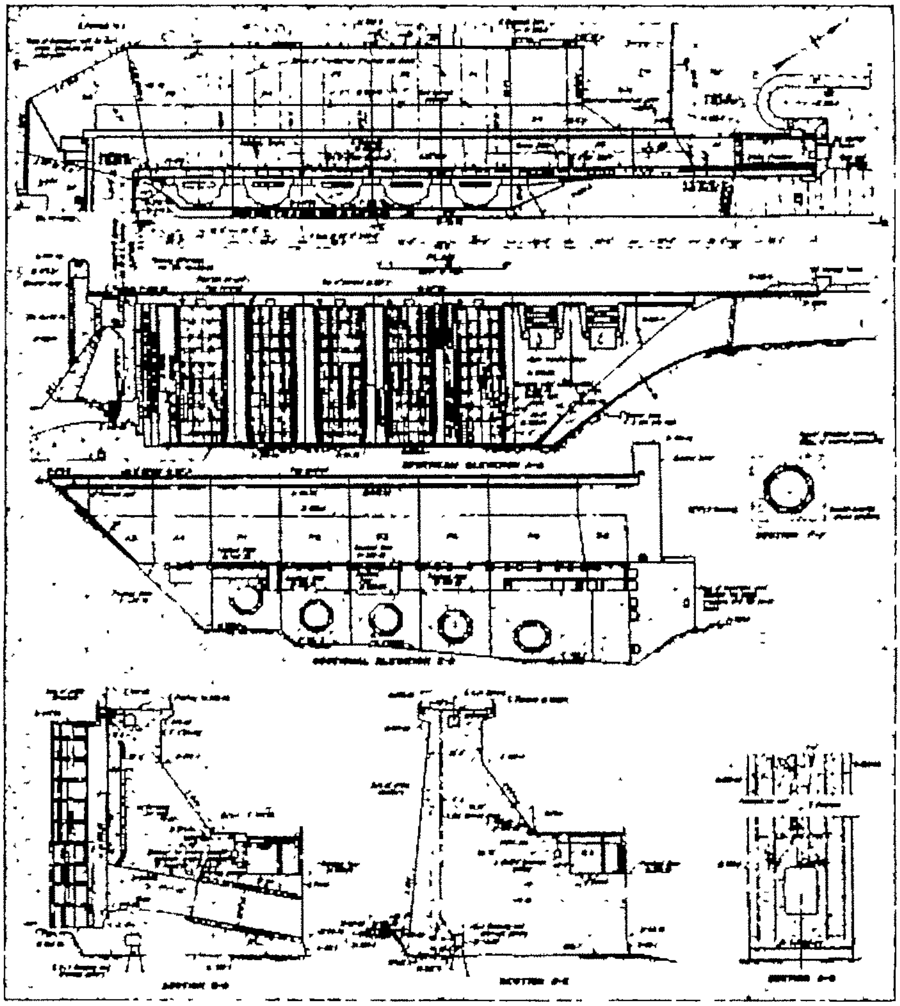

Fig. 3

Intake structure

Construction

The construction programme was divided into three phases. The first phase included excavation of the diversion and forebay channel and completion of the forebay concrete structures to precalculated elevations prior to initial diversion. The initial diversion of the river, which was accomplished through six temporary diversion openings in the spillway structure, started the second phase. This included excavating and unwatering the dam foundation and constructing the earth embankment. Concrete placement was continued on the forebay channel structures during this phase. The third phase involved the completion of the concrete work in the spillway crests. To accomplish this, a secondary diversion through the completed outlet structure was made after the earth embankment and forebay structures had been completed and the penstock fixed-wheel gates and radial outlet gates had been installed.

Diversion works

Before excavation for the dam embankment could be accomplished it was necessary to divert the river from its natural course. The specifications provided a scheme for diversion to serve the multiple purpose of providing (i) a means of unwatering the river in the vicinity of the dam, (ii) suitable semi-pervious and pervious materials for the embankment, and (iii) a permanent channel and forebay for the power plant and spillway.

The diversion channel is mainly in sandy and silty materials. The excavated material from this portion was used to construct the diversion dike on the right bank of the diversion channel and the Arizona approach to the upstream cofferdam. The remainder of the material was placed in a stockpile and was used later in the construction of the dam embankment. The material comprised rock, coarse gravel, cemented sand, and granite boulders. The sand and soft rock were placed in one stockpile and large granite and boulders were placed in a separate stockpile for possible use as riprap.

The method used for stockpiling of materials was to build a ramp and then end-dump or push the material with bulldozers over the edge. This caused segregation of the materials, the coarse rock rolling to the bottom and the fines staying near the top. This method was most suitable because (i) a roadway of fines was required on top of the stockpile, (ii) crushing of rock from truck traffic was confined to the same area, and (iii) segregation occurring due to dumping over the edge of the stockpile could be remedied when material was to be placed in the same embankment by making a shovel cut the full height of the stockpile.

In accordance with the diversion plan, the diversion channel was excavated and the spillway, outlet works and intake structure were first constructed upto a predetermined elevation. Openings in the concrete structures below water level (after diversion) were closed by bulkheads, stoplogs, and timber floors (Fig. 4). The Arizona end of the upstream cofferdam was constructed with waste materials. A pile trestle was constructed to span the remaining distance across the river, and protective rock was dumped in the riverbed at each trestle abutment. The forebay and stilling basin were filled with water through a controlled pipe at the downstream end of the spillway channel. The upstream and downstream diversion channel plugs were them removed. A rock wing dam was built into the river from the Nevada bank opposite the upstream end of the diversion channel. To provide rock for filling the river channel, quarries were established on both sides of the river and rock was loosened and broken by blasting. The closure operations were timed to take advantage of river flow conditions over the weekend, when releases from fhe Hoover Dam were minimum because of low power demand. A fleet of 15 bottom-dump trucks, each of 14 c.yd. capacity, loaded at the Nevada rock quarry, drove over the upstream slot in the trestle and in rapid succession dumped their load into the deepest part of the channel (Fig. 5). After nine hours of dumping, a weir effect was established along the full length of the trestle, and the flow through the channel was reduced from 24,700 to 18,000 cusec. After about

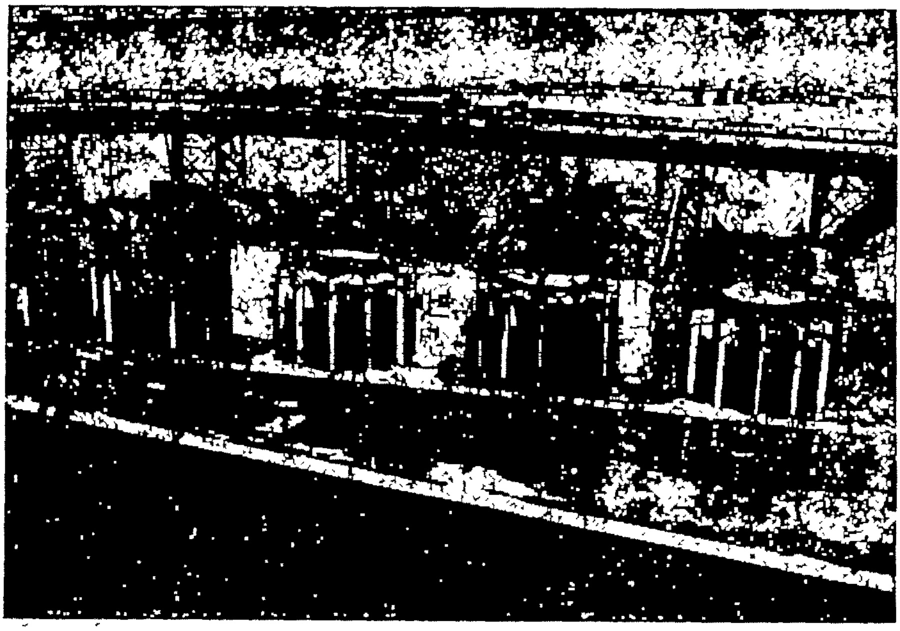

Fig. 4

Diversion wall and stoplogged trashrack structure prior to diversion of the river

24 hours, the flow was reduced to 11,000 cusec.; the level of the upstream water started rising and increasing quantity was flowing through the diversion channel. Dumping was carried on from both abutments, thus gradually closing the gap. However, when the gap was reduced to about 25 ft., the swift current of the river widened the gap to about 50 ft., with rocks as large as 1 c.yd. being carried through the opening by the current. Structural steel sections salvaged from the rock screening plant were placed with a crane and tied to the piling. End-dump trucks were then used for dumping and bulldozers for pushing them into place (Fig. 6).

For the construction of the downstream cofferdam, rock was hauled in end-dump trucks and dumped over the downstream side of the trestle (Fig. 7). After the rock was built up to above the maximum tail water level, clayey material was dumped through the slot at the upstream side of the bridge (Fig. 8).

Second stage diversion was accomplished by placing concrete stoplogs in the diversion slots of the spillway structure causing the reservoir to fill to such an elevation that water flowed through the radial gate controlled outlets.

The final steps in the diversion cycle consisted of gradually closing the radial gates, causing the river to rise and flow over the crest of the spillway, and then gradually closing the spillway gates as each successive generating unit was placed in operation, until it became possible to handle the entire flow of the river through the turbines.

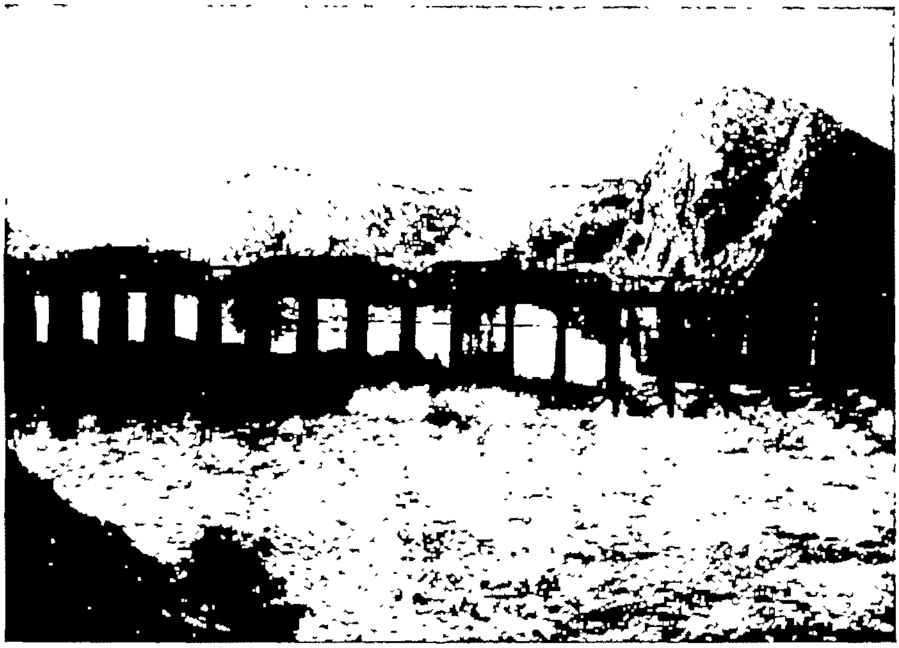

Fig. 5

Bottom-dump trucks discharging rock through slot in the upstream cofferdam trestle

Fig. 6

Final closure of the upstream cofferdam

Fig. 7

Construction of the downstream cofferdam

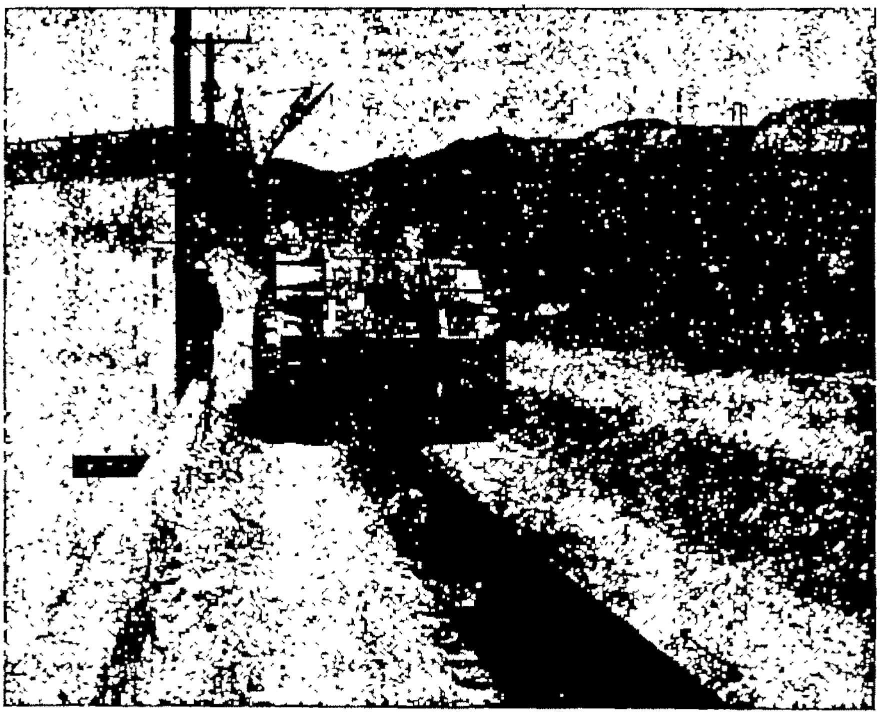

Fig. 8

Bottom-dump truck placing sandy silt matrial through slot in the upstream side of the downstream cofferdam trestle

Earth dam

The first step in the construction of the earth dam was dewatering of the area between the cofferdams. During this operation, a large number of sand boils were encountered, apparently caused by water from the diversion channel flowing under the diversion dike and cofferdam through a pervious stratum near the surface. A single row of well points was placed in operation at the downstream toe of the cofferdam to stabilize the area.

To remove seepage through and under the cofferdams and to lower the ground water level in areas where excavation was to be performed, two lines of well points were installed along the toe of the upstream cofferdam. Perforated steel pipes embedded in gravel were also used for unwatering. A number of methods were used to place the well points. In areas of uniform sand and areas containing only small amounts of gravel or silt, the well points were jetted down without any preliminary preparation. A water hose was attached directly to the top of the riser pipe, and the riser pipe and well point were raised into vertical position with a crane and placed in the desired location. Water was delivered at a pressure of 100 lb. per sq. in. by two gasoline driven pumps. The well point and riser pipe were jetted to the desired depth, after which the water was turned off and the hose disconnected. The entire operation required from 1½ to 2 min.

A jet pipe, 26 ft. long and 8½ in. in diameter, was used to penetrate silt or clay layers. Water and air hoses were attached near the top of the jet pipe, and the pipe was placed vertically over the hole by means of a crane and jetted to the required depth. As soon as water supply was turned off, the cap attached to the pipe was removed and the well point and riser pipe were lowered into the jet pipe. The space between the riser pipe and the jet pipe was then filled with sand and/or gravel for use as a filter to allow water to percolate down to the well point past the silt or clay layers after removal of the jet pipe. The cap was placed back on the jet pipe and air at 100 lb. per sq. in. pressure was used to keep the sand, gravel and the well point in place while the jet pipe was being removed. This operation required 8 to 10 min. for each well point. In some locations, well points were placed in every other hole while the intervening holes were filled with gravel to increase the percolation. The use of jet pipe was also necessary when gravel layers were encountered. Excavation for the dam embankment cutoff trench was begun shortly after the area had been dewatered. Draglines assisted by a power shovel were used for this work.

Owing to material quantity limitations and economic considerations, the dam was divided into three zones for the purpose of construction.

(i) Zone 1: consisting of a core of impervious materials, placed and compacted to 6 in. layers by 12 passes of a tamping roller weighing 4,000 lb. per ft. width of the drum. The foundation for this zone is composed of river fill (some silt but predominately sand), a pervious blanket of unseparated rock at the bottom of the cutoff trench, and the rock abutments. Consolidation of the sandy areas was accomplished by the use of heavy duty water sprinklers and by flooding. Water was obtained from the well point system and was pumped direct to the foundation area to be consolidated. This water then flowed down through the sand to the well points where it was again pumped to the foundation, thus creating a complete cycle. This method of circulating water through the foundation produced noticeable surface consolidation.

(ii) Zone 2: consisting of a transition layer of rock fines upstream and downstream of zone 1. These rock fines were obtained by separating a portion of the rock excavated from the spillway and forebay channel. After moistening and scarifying the fill, the material was placed in 12 in. layers and compacted by eight roller passes.

(iii) Zone 3: forming the outer shell of the dam and composed of (a) an interior fill of unseparated rock, and (b) an exterior fill. No effort was made to compact the materials, the only scarifying done was in areas of heavy concentrated traffic.

The rock for riprap was drilled with wagon drills and blasted in a manner as to produce a well graded product with sufficient spalls to fill the voids. Riprap was placed in the tailrace and on the upstream slope of the dam embankment. It was dumped as nearly into final position as possible and then levelled by a bulldozer. Some hand work was then used to fill voids and to attain grade. The riprap in the tailrace was finished to a much smoother surface than the upstream slope of the dam in order to provide flow conditions that would be most favourable for water discharging from the turbines. The rock at the upstream face of the dam was left rough for dissipating wave action. A sand and gravel filter blanket, 2 ft. thick, was placed under the tailrace riprap, except in certain areas where a natural sand and gravel deposit was left in place to form the blanket.

Formwork

Cantilever forms were used during the construction of the gravity wall, spillway and intake structures (Figs. 9 and 10). Prefabricated forms were used for all wall forms, slabs, beams, columns and parapets, and for forming the upstream and downstream faces of the spillway. Construction joint forms for initial lifts on rock were generally built in place. Stairways presented several problems in forming. Stripping was difficult, especially where the stairs were placed monolithic with the adjoining concrete. Stair risers were stripped and furnished as soon as possible after the concrete had set.

A number of templates were fabricated for holding anchor bars in place and for holding stub angles during concrete placing. One of the templates for holding the generator foundation anchor bolts in alignment is shown in Fig. 11.

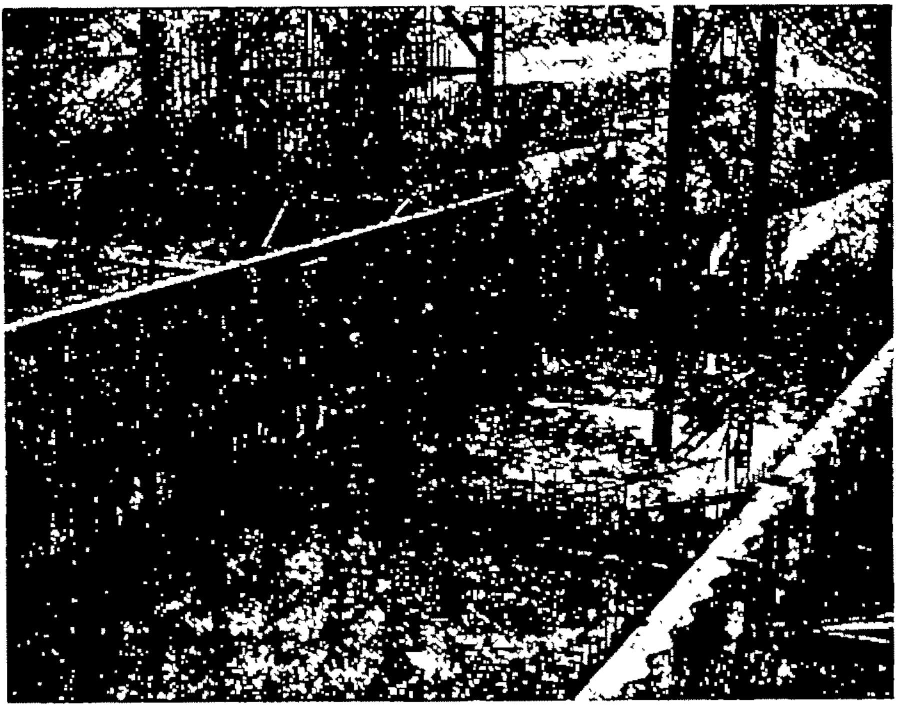

Fig. 9

Cantilever forms used in spillway construction

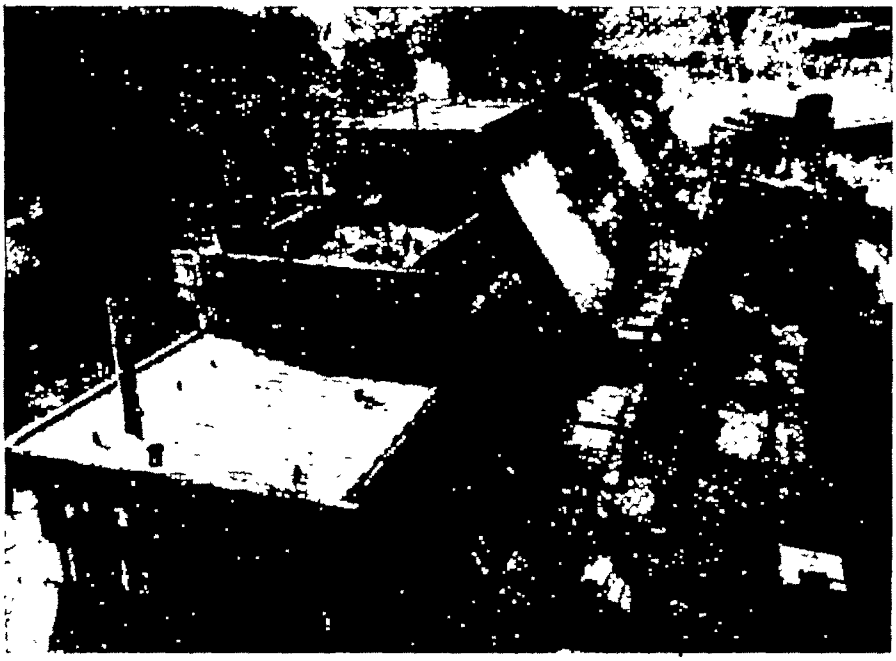

Fig. 10

Cantilever forms used in the intake structure

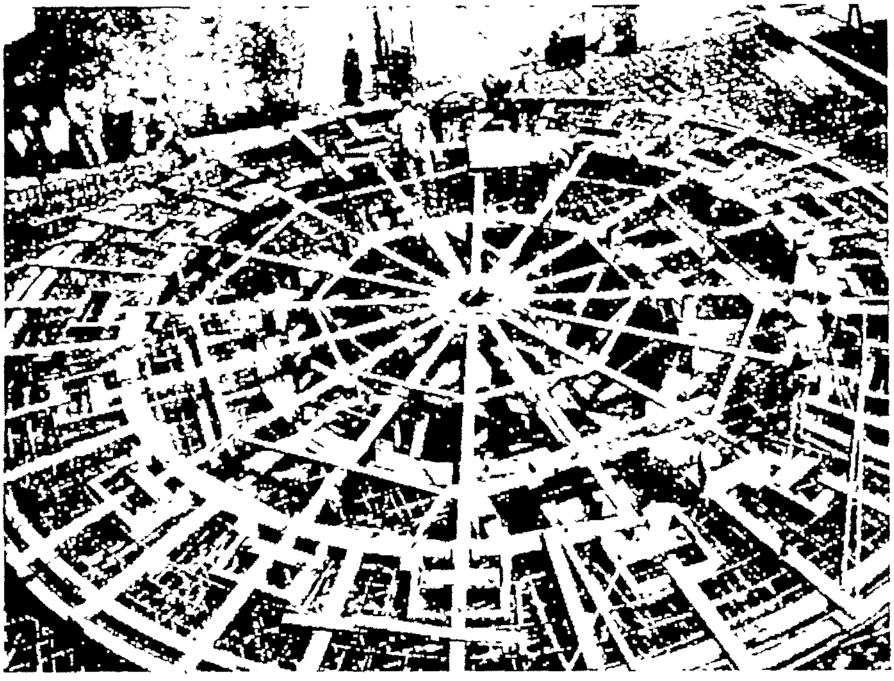

Fig. 11

Templates and forms for placing concrete in generator structure

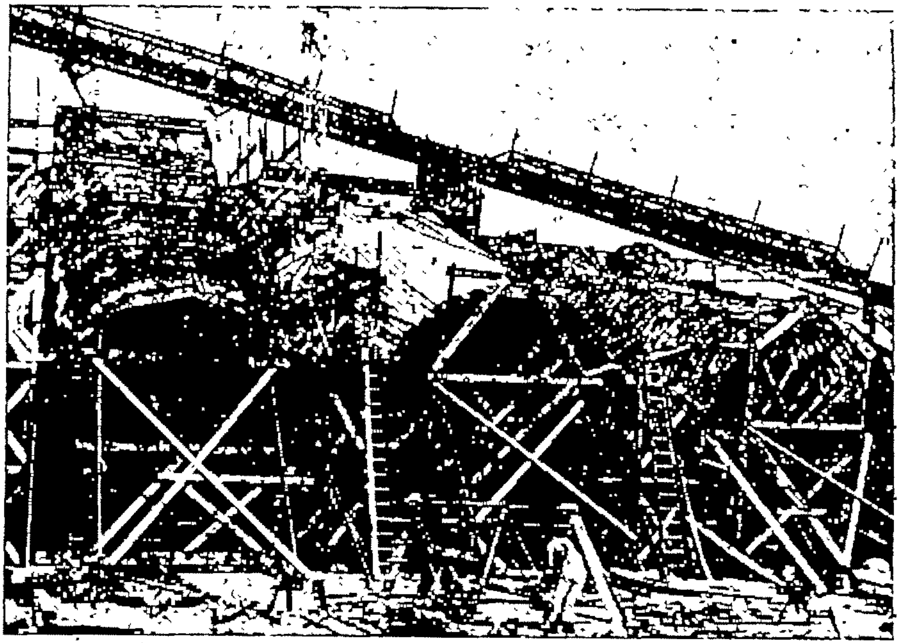

Fig. 12

Penstock transition forms under construction

The prebuilt and furnished penstock transition and draft tube forms (Fig. 12) were hauled to the site by trucks and placed with the help of a gantry crane.

Concrete placement

Grout was used on a large number of horizontal construction joints. Grout was first cross-broomed over an area sufficiently large to permit concrete placing to begin, and then cross-brooming was continued as placing progressed. Where there was seepage on a rock surface, no grout was used but concrete was vibrated well into depressions and along contacts. All piping used for supports and anchors was filled with grout prior to placing of concrete.

Consolidation of concrete was mainly accomplished with internal pneumatic vibrators, but electric vibrators were used in all confined areas which prohibited the use of pneumatic vibrators.

Mass concrete placements were made in rows to form layers approximately 15 in. thick after consolidation. Placing progressed from the downstream to the upstream end. The first bucket was placed in the downstream left corner with succeeding placements in that pass continuing along the form to the right side. The second pass was then placed from right to left, adjacent to but upstream of the first row. This was followed by a third pass which formed a second layer on top of the first row. The fourth pass was placed as the third row upstream and was followed by a fifth pass on top of the second row. Placements continued by steps until the block was topped out. The slope of the concrete was governed by air temperature but was maintained in steps so that concrete could be deposited on a flat surface.

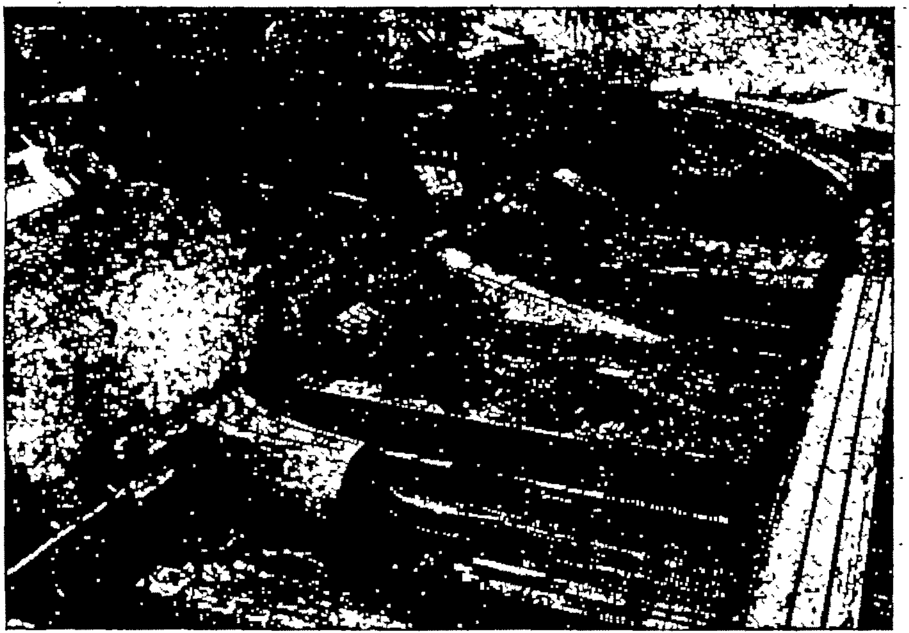

Fig. 13

Penstock transition forms in place in the intake structure with concrete placement at several stages of completion

Concrete containing pozzolan seemed to retain its workability longer than concrete without pozzolan. It was possible even in hot weather to place a layer of fresh concrete on a layer about 1 hr. old and still be able to vibrate the two layers together. In placing the smaller blocks at higher elevations, the entire block was covered with succeeding layers until the block was topped out.

After a mass concrete block was topped out, the placing equipment and vibrators were removed. All open drains were washed out by means of a water hose. Grout lines were blown out with compressed air, and grout vent grooves were washed with water. Hairpins and other anchors or supports needed for the following lift were set in fresh concrete. Finally, 'snowshoeing' of the surface was completed to embed large rocks and provide a relatively even surface.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Bengal Centre

Chairman's address by Shri S. Bandopadhyaya, B.Sc.(Eng.), M.I.E., at the 41st Annual General Meeting of the Centre on December 16, 1961

The Chairman welcomed the Chief Guest, Shri K. K. Sen, Chairman, Calcutta Improvement Trust, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

Delivering his address, Shri Bandopadhyaya said, 'It is relevant to recount the meaning of the word 'engineering', though it is known to most of us. It comes from the French word '*engin*', which means skill and the Latin word '*ingenium*', which means natural capacity and ability. Both Chaucer and Shakespeare have denoted it as one of the three human sapiences. In short, it connotes purposive ability and capacity. Originally, engineering had a limited compass in the building and management of mechanical contrivances and other material objects for human use, but today its range and scope have widened to embrace the concept, creation and fulfilment of all material objects required in the progressive living of mankind. Therein it has a distinct bearing on civilization. It is as much a product of civilization as it is a factor in the building and growth of civilization. Using a mixed metaphor, I call engineering the physical and material construct of civilization. In this context, engineering has two broad aspects. One, the philosophy and the other, the methodology of engineering. I shall deal with these aspects separately and then correlate them in so far as they form the neo-Kantian 'categorical imperatives' for the proper fulfilment of the duties of an engineer.

I will now present a short analysis of civilization and engineering in so far as they have a positive and direct bearing on each other. Such a short analysis would be guilty of the error of over-simplification. However, this is neither the time nor the place for a long discourse with the thoroughness that such an issue demands.

It is difficult to define civilization. The immense depth of its development and the intimate minuteness of its effects make it difficult to form a clear concept of all that it connotes. Broadly speaking, civilization has two distinct aspects for which the terms 'conceptual' and 'material' may be used, though it must be admitted that the line of demarcation between them is very faint and they often merge into one another. In the conceptual aspect, civilization is a process, a flux, a continuum of the thesis, antithesis and the synthesis of all human ideas, thoughts and aspirations. The process is interacting. Man builds civilization and is himself built by it. So is the case in its space-time relations. Though we talk of a particular civilization to specify the period and the place of the development of a type of civilization having certain specific character and features, yet these are not confined, either in the inherent ideas or the practices, to definite space-time contexts. There is something universal in the developing civilization of all countries and times. That is the fundamental nuance of all civilization. Apart from the benefits it has bestowed on man, it has always attempted to be a prime factor in the ultimate emancipation of the human mind towards a goal of peace and understanding. Here also, interaction has played its part. Civilization has grown as much as man has tried to understand man; otherwise, it has decayed and vanished in the backwaters of a temporary material prosperity, whereas the highlights of the thoughts and ideals of all countries and all times have remained as beacons to guide mankind. In my opinion, this is the significant flux in civilization, this universalness in spite of its changing character due to the space-time factor of its development. Thus, civilization has enshrined in the mind of man the idea of truth and beauty, peace and goodwill, progress and harmony in spite of the bickerings and feuds of everyday life. Buddha or Jesus, Lao Tse or Samkara, Homer or Kalidasa, Shakespeare or Rabindranath, Raphael or Michael Angelo, Bethoven or Tansen, all have transcended space and time and are the diverse revelations of this aspect of civilization.

In the material aspect of civilization, man has travelled very far from his ancestors. His inventive genius, constant application and perseverance, capacity to take infinite pains, indomitable will not to surrender to failure, perpetual quest for the better, and higher has enabled him to work miracles. The Olympic motto, *citius altius fortius,* comes to mind. Not only has he attempted a better living for mankind but he has continuously probed into the mysteries and secrets of nature and has gradually enriched himself with her treasures. In this path of trial and fortitude, man has never looked back. He has refused to accept the word impossible. He has delved the oceans, crossed the mountains and soared to the sky and space. He has collected the wealth and power of nature in many forms and is endeavouring to collect more. He has reached the threshold of the meaning of life and death. He is beginning to understand creation. We often hear a common expression that man is conquering nature. Nothing can be more wrong. Man is a babe in the lap of mother nature, fed by her products, enriched by her treasures and envigoured by her powers. Like a fractious child, he is demanding and extracting more from the mother who is smilingly giving it to the pet child. Man is forever attempting to cross the limits of space and time, and that is why he has not only wanted more and better but has consistently striven to build his edifice of knowledge and capability to a permanency. It is true that man is a mere mortal in an ephemerally expressive world, but he has accepted the challenge and has disdained the bonds of mortality. In the world of thoughts and aspirations as well as in the world of activities, man has enriched his storehouse of knowledge to perpetuity. Empires have come and gone, colossal works of human endeavour spread over thousands of years have disappeared into oblivion, yet man has remained steadfast in the pursuit of permanency. This quest for stability in an unstable and continuously changing world is possibly the crowning paradox in human horizon which has made man what he is. In all these attempts, the engineer has played a very important part. Mankind owes a great deal to the engineer in the various fields of achievements. The engineer has built roads, bridges, houses and factories, dug into earth to obtain treasures for his use, invented and constructed steam engine, automobile, aeroplane and rocket, harnessed the forces of nature for his use, and built his citadels of art and learning. Be they matters of immediate importance to human living such as gas, electricity, water supply and drainage, cottages and palaces, roads, bridges, canals, tunnels, mines, factories, railways, steamships and airlines, or be they edifices for perpetuation of art and culture, the engineer has left his milestone in the path of human civilization. Though time has taken its relentless toll yet Rome, Athens, London, New York, Delhi, the Colosseum, the Parthenon and the pyramids, the St. Peter's, the Notre Dame, the Taj Mahal and the Ellora and Ajanta caves remain the saga of the engineer's efforts to immortalize the mortal works of man.

Therein I desire to draw the parallel between the two aspects of engineering and those of civilization. Engineering is as much a science as an empiricism. The scientific side of engineering is organic and creative. It is also universal not only in the sense of the benefits to and uses of mankind but also in the fundamentals of space-time constructs. This must be so, as engineering is built on the basic principles of positive sciences. A more significant factor in this context is that the engineer speaks a universal language. His language of drawings, plans and charts is not circumscribed by the limits of time or by the limits imposed on the world by divisions into countries and peoples. Here the engineer is similar to a painter or a musician. Just before the War, scientists were of the opinion that there may be human life on the planet Mars. An attempt was made for communication with the planet by writing a message in very large dimensions on the Sahara desert which might be seen by the people of Mars. It was the simple idea of signalling on a large scale. The question was what to write? It was felt that letters in any language may not be understood by the inhabitants of Mars. It was, therefore, decided to draw the theorem of Pythagoras. It was rightly felt that a depiction of the universal principles of the geometer will be understood by the people of Mars if they possess thoughts and culture similar to ours.

The engineer does his work for mankind. His work is not shackled by parties and factions or by parochial or communal interests. His mission is to achieve the ends for the benefit of mankind and his efforts are directed to adjust his works to the progressive evolution of human living. He has to build the requisites of civilization and to keep pace with the progressive changes brought about by the process of civilization. In this capacity, he has to be a thinker, dreamer and philosopher as he has to translate into material the thoughts, aspirations, ideas and ideals of progressive humanity. Possibly, engineer is the best example of the transition of homo sapiens to homo faber. But this transition is not a one-way traffic. It is equally true that the homo faber also becomes the homo sapiens. The parallel of the interaction in civilization is again evident. The knowledge derived from executing many works is the seed for the works to come.

It is not necessary to deal at length with the methodological aspect of engineering. Here the engineer is the true homo faber, the supreme artificer. Though various techniques are involved in the process of work, but the efforts and results are specific. So, the parallel with the material aspect of civilization emerges clearly. But methodology can only be successfully achieved by continuous trials and experiments with infinite care and patience. Here the engineer is the empiricist *par excellence*. Controlled and coordinated organization with sustained and patient efforts can only lead to correct and efficient methods of engineering.

I do not know whether I have managed to clarify my thesis. I will attempt to do so by a final exhortation. It is commonly felt that in the comity of social ideas and social values, the engineer is denied his proper place. He is denied the respect and confidence that is properly due to a scientific thinker and worker. These days, particularly in this country, it is common knowledge that the engineer's role has been, for most purposes, reduced to that of a journeyman or a handiman to the administrative overlords. Apart from the propriety and morality of such procedure, even from a pragmatic point of view, this results in a criminal waste of technical personnel. Further, it dampens and thwarts technical progress in the country. I strongly feel it should not be so. But I also feel that the remedy does not lie in propaganda or group campaign but in the efforts of engineers to live up to the ideals of this universal profession. The engineer must dedicate himself not only to his work but also to his ideas and principles unswerved by extraneous pressure. This dedication is not of the order of a *sanyasin* but that of a true teacher or a doctor. It is a question of purposive attachment to the principles of one's work. When we have engineers of this faith and calibre in sufficient numbers, society must accept them as its most useful and necessary members. Engineers must remain the ageless architects of human civilization. Otherwise, they will degenerate into hewers of wood and drawers of water. The Institution must be a body that should look into both the aspects mentioned above. It must inculcate in its members the true purpose and dignity of this noble profession irrespective of external influences. It must accept, believe and spread the gospel of the universal purpose of this profession. In the practical field, it must organize and spread the facilities for coordination and research which are the only means of improving methodology. Otherwise, the Institution will degenerate into a house of trade union, and engineering is not a trade.

I shall conclude with a Vedic *sloka*.

य एकोऽवर्णो बहुधाशक्ति योगाद्
वर्णाननेकान् निहितार्थो दधाति
विचैति चान्ते विश्वमादौ स देवः
स नो बुद्ध्या शुभया संयुनक्तु ॥

(He, that is one and undifferentiated, has, by His infinite powers, revealed to us the inner significance of His many manifestations. He is in the beginning. He is at the end. His effulgence envelops creation. Let Him unite us with understanding and goodwill).'

Delhi Centre

Chairman's address by Shri S. S. Kumar, B.Sc.(Hon.), M.Sc., B.Sc.(Eng.), M.Sc.(Eng.), A.C.G.I., D.I.C., M.I.E., at the 35th Annual General Meeting of the Centre on December 2, 1961

The Chairman welcomed the Chief Guest, Shri Morarji Desai, Finance Minister, Government of India, and other invitees, and thanked the Committee of the Centre for reelecting him Chairman for the year 1961-62.

Delivering his address, Shri Kumar said, 'The Institution is growing in strength from year to year. The membership of the Delhi Centre, which was 700 in 1950, now exceeds 3,000. The Centre is doing a great deal to promote the objectives of the Institution. Steps are being taken to create interest among the Students and Graduates attached to the Centre for participating in the activities of the Institution. For this purpose, periodical lectures and film shows on subjects of interest to engineers are being organized.

The Centre has created a fund for awarding scholarships to deserving and promising candidates for pursuing engineering studies. I take this opportunity to appeal to members, the public, and the Government to donate liberally to this fund.

The five years of the Second Plan were most significant for the engineers, not merely in terms of the successes achieved but also by way of the experience gained by them. In the field of irrigation and power, the country has made rapid strides in the utilization of water and power resources. This is evident from the fact that against the estimated river water resources of 450 million acre-ft. for irrigation, only about 76 million acre-ft. had been harnessed up to 1951; by the end of the Second Plan, this figure increased to about 120 million acre-ft., and the Third Plan envisages the utilization of additional 40 million acre-ft. These figures are exclusive of the sources of ground water tapped for minor irrigation schemes. The area irrigated from major and medium projects increased from 22,000,000 to 31,000,000 acres during the First and Second Plans. The Third Plan aims to raise this target to 42,500,000 acres.

Out of the total outlay of Rs. 7,500 crores in the public sector in the Third Plan, irrigation accounts for Rs. 600 crores. Since such large sum of money is being invested on irrigation projects, it is necessary to ensure that the benefits which accrue from them are not reduced by unwelcome sequels such as waterlogging. It is also essential to so plan the projects that maximum benefits become available in the shortest possible time. Due emphasis has therefore been given in the Third Plan to medium irrigation projects, drainage, and anti-waterlogging schemes.

An important factor in river valley project areas is soil conservation. The dangers of excessive flow of silt and sediment into reservoirs, leading to shortening of their useful life, have been fully recognized. Beside the administrative measures undertaken by the Government, the formation of River Boards for major river basins will further facilitate the execution of soil conservation schemes for the inter-State rivers.

A vital aspect of development of river valley projects is flood control, which has often been linked with storage for irrigation. Although the menace of floods is age-old in India, it has come into prominence only in the recent years. The devastating floods of 1954 gave a start to systematic planning for flood control on a country-wide scale. A three-phase programme consisting of immediate, short term, and long term measures was formulated to deal with the problem.

Conservative estimates place the average annual loss from floods through physical destruction of property at Rs. 50 crores, excluding the expenditure on relief and rehabilitation measures. This amount will be more if the indirect losses suffered by the railways, industries and other revenue earning enterprises are evaluated in terms of money. Besides, there is loss of life, spread of epidemics and, the human suffering and misery that come in the wake of floods. There has been widespread destruction due to floods in Bihar, Orissa, Kerala and Uttar Pradesh. Even Madras and Mysore, which had hitherto no serious flood problem, have suffered heavily. The people may ask as to what the engineers have been doing if, after spending crores of rupees over a number of years, they are still unable to eradicate the evil of recurring floods. To these critics, I shall ask a simple question, 'Which country in the world, afflicted by floods, has been totally freed from them?' America, China, Italy, Phillipines, and others still have flood problems in varying degrees, although no efforts have been spared to tackle them on scientific lines. For example, the U.S.A. is technologically more advanced and economically on a much higher footing than India, there is large store of essential data to serve as a sound basis for planning of flood control schemes, and a large number of storage and other flood control works have been constructed, but the country has yet to find a lasting and complete solution for it. The expenditure for the 28 years before 1956 shows that although about Rs. 2,200 crores were invested on flood control programmes in the U.S.A., catastrophic floods occurred in 1955, and the Government had to spend about Rs. 3,600 crores more. An economically backward country like India can ill afford such large investments on flood control schemes which, unlike irrigation and power projects, are neither revenue earning nor self-supporting. This example underlines the nature of the problem and shows that absolute immunity from floods, though a cherished goal, is difficult to attain. What we can, therefore, aim at is to minimize, with the limited financial resources at our disposal, the human suffering as far as possible.

The problem of floods is mostly misunderstood by the public, with the result that whenever a severe flood occurs, an accusing finger is pointed towards the engineer. In doing so, the critics evidently lose sight of the great complexity of the problem. Firstly, the engineer has to deal with forces of nature on which he has little control and which may sometimes combine to create totally unexpected situations. He has also to deal with the vagaries, idiosyncracies and unpredictable behaviour of the rivers. Moreover, the nature of the problem differs from place to place, and it is impossible to suggest a common remedy.

I will now deal with power development which is a pre-requisite for industrial expansion and overall economic growth. The chronic shortage of power, with consequent retardation of industrial development all over the country, has underlined the need for rapid power expansion.

The total installed generating capacity which at the beginning of the First Plan was 2,300 MW, increased to 3,420 MW during the First Plan and to 5,700 MW at the end of the Second Plan. The generating capacity during the Second Plan increased at the rate of 450 MW per year, and this rate is proposed to be stepped up to 1,500 MW per year during the Third Plan and 2,000 MW per year during the Fourth Plan.

Out of the large allocation for power in the Third Plan, only about Rs. 105 crores have been allotted for electrifying the villages. This amount will enable supply of electricity to 20,000 to 22,000 villages, bringing the total number of electrified villages to 50,000 out of more than 500,000 villages in the country. Power in villages will not only promote cottage industries and provide better employment opportunities, but will positively advance the standard of living of the rural population.

The ambitious programmes in the Third Plan call for considerable introspection and self-criticism. The lessons from the earlier Plans will help to avoid many pitfalls. A good deal of criticism was levelled against engineers in the Second Plan period for lack of foresight and inaccuracy of estimation as evidenced by upward revision of project cost estimates. While it can be shown that much of the criticism was unwarranted, in the case of some of the projects, revision of estimates and important changes in vital technical aspects became unavoidable because project proposals had not been framed on thorough investigations and adequate data.

During the early stages of the First Plan, some schemes had to be implemented without adequate preparation. But the fact that this malady still afflicts our major schemes is sufficient indication that in our anxiety for new projects, the fundamental basis of economy and efficiency through investigation, planning and detailed design has been relaxed.

Our omissions in this regard can only be made up by raising an army of trained personnel, and building up organizations specializing in planning, investigation and design. While in advanced countries, the specialists in the design office are of the highest calibre and form about 40% of the construction staff, in India we have only one designer for about ten engineers in the field. This does not, however, minimize the importance of investigating personnel upon whose initiative, commonsense and energy depends the value of all the data collected for design and construction.

It appears that we have yet to realize that expert investigation or design organizations cannot be created overnight, unlike perhaps administrative or executive departments. To build up a body of technical specialists requires considerable planning, training and experience. The required calibre of engineering talent is available in the country. Dependence on foreign technical assistance does not resound to the credit of the country or help it march forward towards progress. Setting up of competent investigation units and design organizations, both at the Centre and the States, should therefore be given the highest priority.

We have also to investigate our failure to utilize the newly conserved water resources. This calls for definite plan and action. Out of over 10,000,000 acres that were assured irrigation through Plan projects, only a small portion has availed of the expensive facilities to raise the much needed crops. There clearly stands something between promise and achievement. A remedy for this disparity is that the irrigation, the agriculture and the revenue departments actively cooperate with each other from the very inception of a scheme. It is, in fact, necessary that the organizational setup for irrigation projects must include in its personnel agricultural experts at appropriate levels to effect not only immediate utilization of stored waters but also to evolve the best suited crop pattern for the land.

The paucity of foreign exchange is a painful thorn in the path of the Plan. Dependence on foreign countries for supply of machinery and other electrical equipment has been a major obstacle in the attainment of the power target in the Second Plan, during which the programme for the addtion of 3,500 MW generating capacity fell short by about 1,200 MW.

The magnitude of power programme for the Third Plan is more than three times the actual achievement during the Second Plan. The foreign exchange component of the total investment in the Third Plan is of the order of Rs. 330 crores, but various credits, loans and aids cover only about Rs. 250 crores. Apart from the fact that considerable additional foreign exchange has yet to be found, the procedure involved in the allotment and final release of foreign exchange constitutes a bottleneck in the implementation of the Plan programmes. It is, therefore, essential to streamline the administrative and executive machinery to ensure timely release of foreign exchange and its prompt utilization.

The inordinate delays in placing orders for plant and equipment through a multiplicity of governmental channels are well known. I suggest that case studies should be made by high power committees constituted with full powers to place orders within the set target periods, so that the failures of the Second Plan are not repeated during the subsequent Plans.

A lasting contribution towards the solution of the foreign exchange problem will be made when the programme for setting up of manufacturing plants for heavy machinery and heavy electrical equipment in the country is carried out to functional success.

Along with the paucity of foreign exhange are the hurdles of irregularities and difficulties in supply of cement, steel, coal, etc. For timely fulfilment of their requirements, the construction agencies are forced to divert the attention of their key personnel in the time wasting pursuit of the production and control authorities. In this connection, it is pertinent to suggest that the responsibility for keeping up contractual obligations should rest with the respective supply departments. This will enable the construction engineers to perform their legitimate duties which demand their full attention.

The pace of development, particularly in the industrial and power sectors, has suffered for want of adequate and timely transport facilities. The position is not likely to improve in the Third Plan unless corrective measures are taken quickly and promptly. Apart from the railways, which need large expansion, roads and waterways also command an enormous potential. In the national interest, there is no reason why, as in Europe, the U.S.A., and the U.S.S.R., the water transport should not be developed even by subsidy and freight concessions for selected commodities so as to relieve the overburden from the railways.

So far, I have indicated the more glaring lacunae and the requirements for smooth and successful execution of the Third Plan. The first two Plans have brought a revealing experience of the process of planning, and prepared us for planning the future in perspective. So far, the time unit for the assessment of resources, targets and programmes has been restricted to short ad-hoc spans of five years. The choice of this length of time was necessary in the initial stages, but it has certain disadvantages also. It is not conducive to the greatest achievements possible with long range planning. Our resources, needs and targets should be estimated on the basis of, say, 15 to 20 years. Into this period should be dovetailed the Five Year Plans which, in turn, should be made up of precise annual plans. Each plan should flow from the preceding plan and telescope into the next one. We have fairly accurate estimate of our hydro-power land and water potentials. We should now estimate our needs for 15 to 20 years ahead and work for achieving the targets in steps of five years. This technique is not new or unprecedented. A long range Master Plan for every sector of development will ensure greater success for individual plans and result in optimum development of resources.

Finally, I will make a few general observations on the conditions prevailing today. From the stupendous national endeavours we are now called upon to undertake flows a dual responsibility; one for the engineer, and the other for the Government. The opportunity and duty are not merely of the engineer. He inherits them from those who guide him. He assesses the resources and shapes the proposals for future developments, but he can be at his best only in an atmosphere where his problems and difficulties are recognized, he is allowed complete freedom of thought, and there is implicit trust in his actions. However, the climate today is different. He is given more than his share of subordination, suspicion and needless curbs. I wish that we take a lesson from Gandhiji who said, 'Trust a man, and he will live up to it; distrust a man, and he will live up to it.'

The engineer's position of high responsibility without commensurate authority, liberty of action and trust can only end in frustration. He can deliver the goods only if he is given a free hand and the necessary encouragement. The decision of the Government to constitute an All-India Service of Engineers is a welcome step in this direction. But, what the engineer needs today for maximum output is a sense of independence and equality, an opportnity to be heard directly at the highest policy making levels, and a chance to work in freedom at the highest level where only the technical talent can deliver the goods. I am reiterating the unanimous voice of the recent Symposium on 'Economy and Efficiency of Engineering Enterprises in India', held in November 1961 at Delhi under the auspices of the Institution, which laid bare the national loss which results in placing non-technical men at the head of technical enterprises.

I am confident, Sir, that with your understanding, vision and dedication to the national cause, you will lend your powerful hand to break the binding fetters of Prometheus, *i.e.*, the engineering and technical talent in India. And we promise to you, Sir, that given due freedom and recognition, we shall shape the national aspirations in the best form, in the shortest possible time and at the least cost to the nation.'

Summaries of Papers Published in the Journal, vol. 42, no. 6, pts. EL 3 & CH 2, February 1962

ELECTRICAL ENGINEERING DIVISION

Starting Performance of Three-Phase Salient Pole Synchronous Motors with Solid Pole Shoes

K. C. Mukherji

The paper is a recast of an original treatment by Jan Basta into a form considered suitable for adoption as a routine procedure in a machine design office for predicting the asynchronous speed-torque characteristics during starting of salient pole synchronous motors and condensers fitted with solid pole shoes.

Proceeding closely along the lines of a linear unidimension field problem, the power factor of the solid rotor is established as $\frac{1}{\sqrt{2}}$. However, in determining the actual rotor circuit parameters of the equivalent circuit, the operative value of the permeability is considered to be determined by the tangential magnetic intensity on the rotor surface. The circular arc locus of the stator current is then used for determining the asynchronous speed-torque characteristics. The method is illustrated for the case of a large synchronous motor, assuming values of the starting currents for different applied voltages, and the calculated speed-torque characteristics are compared with those obtained from test results.

Transformer with Additional Winding and Its Effect on Voltage Regulation

R. K. Khare

Non-member

In this paper, it is shown that in a transformer with two secondary windings, main and auxiliary, the latter developing a lower voltage than the former, if an auxiliary winding is connected to the main secondary winding such that the terminal voltage is the vector difference between the voltages across the two secondary windings, then the regulation of the terminal voltage will be much better than in a conventional two-winding transformer.

A Modified Approach for Finding Out Critical Clearing Angle in a Single Machine Stability Problem

Y. G. Paithankar

Non-member

The paper deals with a modified method for finding out the 'critical clearing angle' for a single electrical machine connected to an infinite busbar. The method can be extended to problems involving two or three machines. There are two conventional methods for finding out the critical clearing angle: (i) point-by-point solution of the swing equation, and (ii) equal area criterion. The method described is analytical and hence, when compared with the point-by-point method, it obviates laborious calculations to a large extent.

Design of Electrical Power Machines

S. H. Raj
Associate Member

The conventional method of finding out the working volume of an electrical machine from the rated capacity and its r.p.m., and then splitting it for the diameter and length of the machine is still adopted in many countries for the design of electrical power machines. In this paper, a new method called 'design by division coefficient between perfect and imperfect similarity' is presented, and illustrated by means of an example. It is observed that the method is less cumbersome and more specific than the conventional method.

CHEMICAL ENGINEERING DIVISION

Biochemical Utilization of Distillery Spent Liquor

Dr. T. K. Ghose
Non-member
S. K. Basu
Non-member
M. K. Ghose
Non-member
S. R. Kundagrami
Non-member
and
B. C. Bhattacharyya
Non-member

Industrial alcohol is one of the basic raw materials for organic chemical industries. It is produced by fermentation of cheap carbohydrate materials. For each gallon of 96% alcohol production, 10-15 gallons of waste known as 'distillery spent liquor' or 'distillery slop' is produced. This constitutes one of the most hazardous waste materials confronted by the distilleries, with pollution load ranging between 30,000 to 35,000 p.p.m. B.O.D. Based on the 1965-66 target figures for alcohol production, the total discharge of raw slop in the country will be in the neighbourhood of 2 million gallons every day. This quantity of slop represents a pollution capacity of 55 million people.

The high acidity of the waste affects the natural biological flora including fish. Thus, it is far from desirable to permit the waste to flow into the stream without being treated.

Present studies show that this waste can be utilized in both methane formation and sulphide production. The enriched cultures of *Methanobacterium söhngenii* and *Desulphovibrio rubentschikii*, for methane fermentation and sulphide production respectively, developed at the laboratory have established their capacity to tolerate high concentrations of volatile acids and intensive rate of sulphate reduction in laboratory studies. It has been possible to reduce the B.O.D. of raw spent liquor from 30,000-35,000 to 1,000-1,200 p.p.m. by two-stage (liquefaction and gasification) methane fermentation during a total hold-up period of 10 days. Simultaneously, the same waste can be utilized for reduction of mineral gypsum to sulphide (which can be converted to elemental sulphur by partial oxidation into 25.45 kg of S per 2,250 litres of waste treated. During sulphate reduction, the C.O.D. (chemical oxygen demand) of the waste is reduced by 78-80%. It is further observed that in the disposal of distillery spent liquor the following valuable products are available per 5,000 litres of waste treated: (a) 75,000 litres of total gas, (b) 45,000 litres of CH_4, (c) 6,000 litres of H_2, (d) 22,500 litres of CO_2, (e) 27 kg of sulphide, and (f) 21 kg of potash (computed on the basis of about one-third of the weight of ash).

A scheme for conducting further pilot plant studies on linked fermentations comprising methane and sulphide production is proposed in the paper.

Adiabatic Extrusion of Thermoplastics

M. V. Joshi

Member

and

K. A. T. Varghese

Non-member

Extrusion of thermoplastic materials is an efficient and versatile method and is being increasing used in the plastic industry. Adiabatic extrusion of polyethylene and two different samples of plasticized polyvinyl chloride moulding compositions were studied in detail. The results given in the paper indicate the variation in temperature and pressure of the material with the speed of the extruder. Calculations are made to study the manner in which power supply to the machine is utilized under adiabatic conditions. In order to study the problem of adiabatic extrusion in detail, it is necessary to carry out experiments with screws having different dimensions, and also with different types of thermoplastic materials.

INSTITUTION NOTICES

Studentship Examination

The Council at their 421st Meeting held in Delhi on November 14, 1961, decided to continue to hold the Studentship Examination. The minimum educational qualification for candidates to apply for Studentship as recognized by the Council is S.S.L.C. or its equivalent. Students having similar academic attainments may apply as per old rules. The notices appearing on page 40 of the *Bulletin* for March 1961, and page 11 of the *Bulletin* for May 1961, with regard to the abolition of the Studentship Examination from November 1963, are therefore cancelled.

Time limit for appearing in Studentship Examination

The Council at their 422nd Meeting held in Calcutta on February 4, 1962, decided that candidates whose cases are approved for admission to the Studentship Examination will be required to pass the examination in the five immediately following examinations from the date of intimation of approval of their cases, failing which the approval of their cases will be cancelled.

Increase in fees for Associate Membership Examination in Sections A and B

The Council at their 422nd Meeting held in Calcutta on February 4, 1962, decided to increase the examination fees for the Associate Membership Examination in Sections A and B from Rs. 50 to Rs. 75, with effect from the November 1962 examinations for the new scheme of examinations.

Opening of a new examination centre at Bhilai

The Council at their 422nd Meeting held in Calcutta on February 4, 1962, have decided to open a new examination centre in Bhilai with effect from the May 1962 examinations.

Additional Referee for Poona Centre

The following member is an additional referee to the list which appeared in the *Bulletin* dated October 1961.

47. AM 4697 Col. R. Janardhanam (M.E.)
Institute of Armament Studies, Kirkee, Poona 3.

Misdemeanour in the Institution examinations

The Council have decided to cancel the results of the following candidates for the May 1962 examinations and debar them from appearing in the three immediately following examinations, *i.e.*, up to and including November 1962, for misdemeanour at the aforesaid examination.

Roll No.	Name	Studentship No.
1555A	Bishnu Charan Chowdhury	S. 25468
3223A	Inder Singh Suhag	S. 10928
3257A	Prakash Dev Luthra	S. 3997
3444A	Bhagirath Mal Goyal	S. 25570

Draft Indian Standard

The following draft Indian Standard has been issued recently.

1. Draft Indian Standard Code of Practice for Use of Welding in Structures Subject to Dynamic Loading—Doc : SMDC 15 (192).

The Code of Practice applies to welding of structures subject to dynamic loading, to be used in conjunction with the following codes : (i) IS : 1915-1961—Code of Practice for Steel Bridges, (ii) IS : 807—Code of Practice for Design of Cranes and Hoists, and (iii) IS : 800-1956—Code of Practice for Use of Structural Steel in General Building Construction.

Members may send their comments on the above draft Standard before March 31, 1962, to Shri B. N. Majumdar (*A.M.*), 1 Ganesh Chandra Avenue, Calcutta 13, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 14/69 Civil Lines, Kanpur; or 2/21 First Line Beach, Madras 1.

INSTITUTION NEWS

Foundation stone laying for the building of the Jammu and Kashmir Centre

The foundation stone for the building of the Jammu and Kashmir Centre was laid by Shri Bakshi Gulam Mohammad, Prime Minister of Jammu and Kashmir, at Srinagar on November 5, 1961. The land for the building and a sum of Rs. 50,000 for its construction have been donated by the State.

The foundation stone laying ceremony was attended by Maj.-Gen. Harkirat Singh, President, and a large number of invitees and guests.

FORTHCOMING CONFERENCES

Eighth Irrigation and Power Seminar, Ootacamund, May 1962

The Eighth Irrigation and Power Seminar which was scheduled to be held in Poona, as published on page 15 of the *Bulletin* for July 1961, will now be held in Ootacamund in May 1962. The exact dates of the Seminar will be announced later.

Further details regarding the Seminar can be had from the Deputy Director (Seminar), Central Water and Power Commission, Bikaner House, Shahajahan Road, New Delhi.

Third Congress of the European Federation of Chemical Engineering, London, June 20-29, 1962

The Third Congress of the European Federation of Chemical Engineering will be held at Olympia, London, from June 20-29, 1962. The technical programme of the

Shri Bakshi Gulam Mohammad, Prime Minister of Jammu and Kashmir, Laying the Foundation Stone for the Building of the Jammu and Kashmir Centre

Congress includes symposia on 'Interaction between Fluids and Particles', 'The Handling of Solids', 'Process Optimization', and 'The Physics and Chemistry of High Pressures'.

Further details regarding the Congress can be had from The Congress Secretary, The Institution of Chemical Engineers, 16 Belgrade Square, London, S.W.1.

Conference on Hydraulics and Fluid Mechanics, University of Western Australia, Perth, December 6-13, 1962

A Conference on Hydraulics and Fluid Mechanics will be held at the School of Engineering, University of Western Australia, Perth, from December 6-13, 1962. Completed papers or interim reports on work in progress in the field of hydraulics and fluid mechanics are invited for presentation at the Conference.

Further details regarding the Conference can be had from Mr. R. Silvester, Convenor of the Conference on Hydraulics and Fluid Mechanics, School of Engineering, The University of Western Australia, Perth, Australia.

BOOK ACKNOWLEDGMENTS

1. **Moment Distribution.** E. Lightfoot. *E. & F. N. Spon Ltd.*, 67s. 6d. 363 pages.

This book dealing with the theory and applications of the moment distribution method for the analysis and design of rigid jointed structures is intended to serve as a reference book for practicing structural engineers and a textbook for post-graduate and undergraduate students of engineering colleges and universities. It includes a number of new design procedures making use of the moment distribution method and the modifications required to allow for different structural effects.

2. **Steel Structures.** N. R. R. Rao. *Saroj Prakashan*, Allahabad, Rs. 10. 320 pages.

This book dealing with the properties and general design of structural members and joints is intended to cater for the requirements of students preparing for civil engineering degree examination of Indian universities in the subject of steel structures.

3. **Armature and Field Coils.** K. Wilkinson. *E. & F. N. Spon Ltd.*, 35s. 224 pages.

This book presents a description of the types of coils, methods of winding and testing of the different types of armature and field windings commonly used for small electric motors.

4. **A Text Book of Public Works Accounts.** S. C. Dikshit. *Subodh and Co.*, Roorkee, Rs. 9. 244 pages.

This book is intended to serve as a textbook in public works accounts and a guide to engineers and overseers working in the Government engineering departments. It deals with methods of maintaining important records and avoiding common mistakes, and gives the rules and practices followed in the Central and Public Works Departments.

5. **Flow Measurement and Meters.** A. Linford. *E. & F. N. Spon Ltd.*, 70s., 2nd edition. 430 pages.

This second edition of a book dealing with practical applications of the theory of metering the flow of fluids through close and open conduits has been revised and expanded to include the advances made in the techniques of flow measurement. The book also gives the advantages, limitations and applications of the different types of flow meters.

NAMES OF SUCCESSFUL CANDIDATES IN THE STUDENTSHIP AND ASSOCIATE MEMBERSHIP EXAMINATIONS HELD IN NOVEMBER 1961

The following candidates have been declared to have passed the Studentship and Associate Membership Examinations held in November 1961.

STUDENTSHIP EXAMINATION

Roll No.	Name of candidate	Roll No.	Name of candidate
St. 4	Rooparam Shahu	St. 394	Mathra Das Arora
St. 15	J. Venkatadri	St. 400	M. K. Mehra
St. 18	C. Venkatesa Prasad	St. 422	R. N. Tripathi
St. 20	H. N. Aithal	St. 429	Sheo Saran Singh
St. 28	N. Santhanaraman	St. 445	M. V. Jogarao
St. 32	M. L. Rustagi	St. 459	P. R. Sankaranarayanan
St. 33	Jacob Varghese	St. 461	K. Ananthram Prabhu
St. 35	S. Abdul Azeem	St. 464	T. S. Subbarathinam
St. 36	V. Vaidyanathan	St. 465	V. P. Rama Rao
St. 48	V. L. Thomas	St. 483	S. Sethumadhavan
St. 54	P. P. Paul	St. 494	J. Nithyanand Iyer
St. 75	M. V. Joshi	St. 520	M. Krishna Murty
St. 91	Hari Dev Vaid	St. 552	V. Rajamani
St. 93	R. Narayanan	St. 553	M. Venkateswaran
St. 100	H. S. Marvaha	St. 569	D. S. Subbarayan
St. 111	M. H. Purandare	St. 584	K. S. Jayaraman
St. 136	V. T. Raste	St. 597	K. K. Ravindranathan
St. 153	Arun Hari Apte	St. 603	R. Rajamani
St. 208	Labh Chand	St. 607	M. S. Ameer Batcha
St. 250	V. M. Gadre	St. 608	R. R. Gulrajani
St. 269	D. S. Bhatia	St. 626	M. Balaramaiah Setty
St. 272	Gopal Krishan Gulati	St. 636	D. Narayana Rao
St. 281	Balbir Singh Budhraja	St. 641	Ragbhir Singh
St. 317	Bimal Chandra Mohan	St. 681	M. K. Mukherjee
St. 323	K. Sai Baba	St. 687	Bhola Mandal
St. 325	M. Nageswara Rao	St. 703	Shantaram Mahipat Sonar
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St. 338	P. M. Mohan Rao	St. 730	B. Thankappan Nair
St. 350	K. Harinarayana	St. 734	K. Kumaran Divakaran

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A

Roll No.	Name of candidate
1A	Jayantkumar V. Thakkar
29A	M. P. Singh
31A	P. B. Kaneria
52A	Ramesh Chandra Sehgal
100A	M. M. Chhugani
110A	N. Singlachar
111A	C. R. Narayanan
113A	C. S. Sampath
114A	S. R. Shankaranarayana Rao
116A	Mirza Hyder Ali Baig
123A	B. N. Sampath Kumaran
125A	T. Palani
128A	H. V. Sampathu
137A	P. V. Balarama Gupta
147A	Ramachandra Guptha
156A	B. S. Dattatri
160A	Krishna Swaminathan
173A	Belur S. Ranganath
182A	R. Keshava Swamy
193A	Mrinmoy Kanti Dasgupta
228A	K. N. Shivashankara Rao
232A	T. G. Joy
242A	Prem Parkash Dogra
245A	M. K. Raj
276A	P. Vasudeva Rao
290A	N. Balakrishna
292A	S. Rangarajan
303A	Jaidev Singh Chandhoke
328A	N. T. Siddaramannanavar
372A	Mohammed Munnawar Ali
413A	K. N. Krishna Prasad
425A	T. C. Panduranga Rao
445A	M. Chandrashekar
525A	Y. R. Khadilkar
540A	Madhusudan Jekisondas Parikh
563A	N. K. Gharat
590A	T. N. Shaldar
602A	R. K. Baldua
615A	Shyamsunder K. Tibrewala
635A	G. Manaharamani
660A	Dhirendra Jamnadas Udeshi
696A	A. N. Gersappa
751A	K. Madhavan Pillai
758A	P. N. Kota
799A	Subramanian Ganapati
831A	V. Mahadevan
848A	V. N. Jayaraman
874A	S. Subbiah
896A	L. V. Bhatt
901A	M. G. Papsare
947A	Nimai Kumar Das
969A	Mridul Baran Dutta
976A	P. R. Krishnamurty
978A	A. Radhakrishna Moorthy
993A	Ramari Bhattacharyya
996A	Hiranmoy Sen Gupta
1033A	Narayan Chandra Mukhopadhya
1038A	Madan Mohan Mukhopadhyay
1060A	Madan Mohan Patra
1120A	Asish Kumar Banerjee
1159A	Shamsher Bahadur Saxena
1184A	Debdas Bandyopadhyay
1202A	Mihir Kumar Sinha
1236A	Amiya Kumar Ghosh
1251A	Asish Kumar Sarkar
1267A	Mahesh Chandra Shah
1273A	Paritosh Dutt
1279A	Champak Kumar Bose
1282A	Deba Prosad Sett
1284A	Asoke Kumar Paul
1287A	Ranjit Kumar Mazumdar
1291A	Bhaskar Nath Barat
1292A	Mukunda Dev Bhattacharyya
1305A	Pranay Krishna Mukherjee
1338A	Parshu Ram Choodhary
1343A	Dipak Sen Gupta
1354A	Nirmales Nandi
1358A	Ram Krishna Bhattacherjee
1393A	Radha Nath Das
1414A	Sanjit Kumar Basu
1437A	Asim Kumar Sarkar
1448A	Paritosh Ghosh
1466A	Tushar Kumar Ghosh
1505A	Shyam Lal Kohli
1513A	Samarendra Nath Chakrabarti
1595A	Syed Abdul Alim
1598A	Dipak Kumar Banerjee
1600A	Molleti Sankaranarayana
1627A	Subhas Ranjan Sen Gupta
1634A	Salil Kumar Banerjee

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate
1638A	Shaktimoy Bandyopadhya
1646A	Arun Kumar Goswami
1657A	Ganapat Lal Toshniwal
1663A	Ajit Kumar Gupta
1729A	Sunil Chandra Mukherjee
1770A	Pranab Nath Chakravertty
1795A	Bijaya Kumar Patra
1811A	V. Narayanan
1847A	Surendra Panda
1867A	A. K. Das
1890A	Darshan Lal Rewri
1903A	Dau Dayal Saxena
1909A	Satya Murtie Jain
1911A	Krishna Murti Garg
1914A	Sunder Singh
1917A	Satish Chandra
1971A	Bhim Sain Nakra
1973A	Mahesh Kumar Jain
1974A	Sumran Lal Garg
1981A	Gyanendra Kishore Mathur
1982A	Ishwar Chand Mittal
2005A	Satish Kumar Sharma
2007A	Sat Parkash Sud
2018A	Mulk Raj Dhall
2038A	Anand Behari Tyagi
2042A	Sat Pal Singh Dogra
2066A	Prem Chand
2090A	Krishna Kumar Dass
2093A	Amrit Lal Aggarwal
2098A	Sant Ram Goyal
2129A	Lakshmi Narayan Yadav
2139A	Dalip Singh Thukral
2141A	Inder Mohan Handa
2144A	Onkar Singh
2150A	Satya Pal
2161A	Nand Kishore Sharma
2173A	Kulbir Krishan Bhatia
2198A	Bala Prashad Agrawal
2231A	M. I. Philip
2271A	Krishan Chand Sharma
2296A	Rajinder Mohan Singh
2341A	Tarlok Singh
2344A	Inder Singh Sulakh
2350A	Manohar Lal Gogna
2439A	Ram Sarup Lumial
2447A	Rangaswami Vasudevan
2499A	Ranbir Singh Bajaj
2528A	P. N. Narayanan Nair
2541A	Lachhi Ram Gupta
2548A	Ish Kumar Sehgal
2557A	Mrinmoy Bhattacharya
2558A	V. K. Gupta
2578A	Prahlad Chandra Mathur
2579A	Parabh Dyal Satija
2595A	Suraj Prakash Chand
2646A	J. R. Nigesh
2651A	Rajeshwar Sahai Saxena
2665A	Om Prakash Kakar
2673A	R. S. Bhatnagar
2695A	Kuldip Chandra Vij
2727A	V. M. Agarwala
2774A	Jonna Adinarayana Rao
2829A	Ramesh C. Sood
2834A	Satya Paul Nangia
2854A	Kasturi Lal
2938A	K. V. S. Mallikarjuna Sarma
2976A	N. Ramachandra Rao
2996A	K. R. G. M. Anilkumar
2998A	Upendra Nath Dixit
3003A	D. V. L. Narasimha Rao
3020A	V. V. L. Narasimham
3024A	Gajula Krishna Rao
3027A	K. B. Mohana Rao
3028A	B. Venkateswara Sarma
3056A	Narendranath Mohanty
3057A	Y. Sri Hari Rao
3063A	K. Mohan Prasad
3068A	A. Venugopala Rao
3073A	K. S. R. K. Haragopal
3080A	Putla Rajendraprasad
3083A	Saripally John
3088A	Kodali Madhusudhanarao
3128A	B. Sreenivasa Rao
3153A	V. Ramamurthi
3166A	K. Chalamayya
3189A	D. S. Sarma
3225A	M. Raghavaiah
3232A	S. M. Hussain
3250A	Gude Santha Rao
3253A	T. Rama Mohan Rao

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate	Roll No.	Name of candidate
3272A	Udai Pal Singh	4345A	Kakani Rama Mohana Rao
3282A	Ram Kumar Govil	4350A	Ram Sham Sinha
3287A	M. A. Salam Siddiqui	4350A	Ramjanam Sinha
3289A	Balkrishna Sharma	4355A	R. S. Sudhakara
3325A	K. Sundaram	4359A	V. S. Murthy
3455A	Vishwa Patilal Pandya	4360A	V. Ramanuja Rangan
3460A	Harendra Kumar Garg	4366A	O. Bala Obula Reddy
3470A	Chander Jaisinghani	4372A	Harideo Jha
3480A	Ram Singh Sharma	4382A	Suresh Chandra Mall
3502A	Sham Sundar Nandwani	4392A	Sethurama Rajagopalan
3535A	Udai Chand Jain	4399A	P. Ramanna
3570A	P. C. Mangal	4401A	M. Srinivasan
3757A	Hari Dutt Sharma	4406A	Nanda K. Satpathy
3813A	Prem Nath Jhingran	4407A	S. C. Pattanaik
3855A	Brij Raj Kishore	4439A	P. S. R. A. Vital Rao
3863A	Satya Pal Puri	4494A	J. Subba Rao
4010A	Bal Krishna	4519A	K. Ramakrishnan
4033A	Mahendra Kumar Gupta	4562A	S. Mahadevan
4049A	Ram Swarup Mitra	4563A	E. K. Visvanathan
4065A	Dhrubendra Chandra Mahapatra	4569A	D. Rangarajan
4074A	Sachidananda Panigrahy	4576A	Shaikh Fakiruddin
4077A	K. M. Thomas	4579A	Gour Charan Mahanta
4087A	Santosh Kumar Panigrahi	4598A	G. Hanumannarayana
4101A	Gouranga Charan Samal	4611A	K. Y. Narasimhan
4107A	Ramier Anantha Rama Krishnan	4623A	M. S. Kulkarni
4109A	N. Jayaram	4641A	K. Swaminathan
4114A	K. N. Ramalingam	4643A	K. Kalicharan Dora
4123A	A. V. Rama Mohana Rao	4659A	R. V. Rama Subramani
4124A	V. Suryanarayana Murty	4663A	A. K. Jagaty
4125A	Mahammed Umar	4685A	M. Sarveswara Sarma
4135A	N. V. R. Gopalakrishna Sarma	4756A	C. Polke
4152A	A. Madhusudhana Rao	4779A	A. C. K. Radha Krishna Murty
4178A	M. Suryaprakasa Rao	4839A	Hardyal Singh Saroa
4182A	Venkanna Kesavalu	4853A	Kartar Singh Dahiya
4188A	N. Raghimathan	4869A	Raghuvir Lal Sehgal
4189A	V. B. Rajendra Prasad	4870A	Om Prakash Verma
4201A	Satya Narain Sharma	4872A	Divender Singh Saggu
4208A	Channamsetti Venkata Rao	4947A	Swarn Singh Aulakh
4246A	Krishnamurti Sankaran	4976A	Krishan Kumar Kasturia
4263A	K. Subrahmanyam	5008A	Ramesh Chandra Mathur
4265A	Dukkipatti Purnachandra Rao	5010A	Rajinder Singh
4266A	J. V. R. Subba Rao	5041A	Som Nath Gandhi
4273A	T. V. Srinivasan	5051A	J. P. Kaushish
4297A	Mudrageda Venkata Rao	5057A	D. R. Alwadhi
4344A	Challa Venkata Siva Reddy	5082A	Dev Datt

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate	Roll No.	Name of candidate
5119A	Shanti Sarup Sanger	5565A	S. D. Dake
5197A	Mahendra Prasad Choudhary	5592A	Y. T. Hosmani
5217A	K. K. Prasad Sinha	5593A	M. S. Shinde
5276A	Gopendra Narayan Bhowmik	5599A	Manabendra Roy
5327A	Sukumar Mukherjee	5602A	Syama Pada Kole
5342A	Devendra Singh	5621A	M. S. Setty
5351A	Indu Bhushan Prasad	5641A	Roshan Lal
5376A	Rajeswari Prasad Singh	5700A	N. Sreedharan Pillai
5475A	P. T. Kochu Mathew	5719A	P. K. Dev
5485A	Shrikant Vithal Sathe	5733A	T. Babu Rajan
5493A	Dinkar P. Gokhale	5739A	M. V. Ganesan
5493A	Abdulrahim A. Kazi	5745A	K. Parameswaran Pillai
5533A	K. M. Kanchwala	5764A	P. K. Kurian

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B

Roll No.	Name of candidate	Roll No.	Name of candidate
1B	Triloki Nath Ganju	136B	Farok Darabsha Deboo
2B	Atu Ramchand Ajwani	137B	Jaiwant Shanker Parab
3B	H. S. Jaganath	147B	Vasant Hanamantarao Kulkarni
4B	Anant Keshav Kulkarni	152B	Om Parkash Diwan
8B	Bansi Lal Panwar	153B	Shashikumar N. Karekar
11B	N. G. Sreenivasan	155B	G. Seshagiri Rao
16B	C. Gopal Iyengar	158B	Jamshed Rustom Cooper
17B	Satishwar Dayal Mathur	161B	K. Sambasiva Rao
18B	D. S. Nagaraja	178B	M. D. Kamath
43B	G. Venkateshaiah	183B	Charan Santdas Advani
48B	H. Satyamurthy	185B	D. M. Dandekar
53B	A. S. Ramakrishna Rao	198B	Sunil Kumar Roy
54B	Motilal F. Jiandani	199B	Manik Lal Hajra
57B	B. R. Pandarinath	202B	Kartik Chandra Manna
60B	A. N. Ranga Raj	211B	Sanjit Kumar Bose
61B	P. R. Srinivasan	216B	Jagat Mohan Khadanga
62B	M. B. Nagaraja	220B	Apurba Kumar Poddar
64B	D. R. Joshi	221B	Santi Moy Sinha
66B	Mohan Singh	228B	Sitangshu Kumar Bhanja
67B	A. N. Sreepada Rao	231B	Amiya Ranjan Banerjee
75B	T. B. Puttaswamy	232B	Thakurdas Bhattacharyya
86B	D. Lakshminarasimham	243B	Samir Kumar Das
89B	V. K. Srinivasan	261B	Ram Chandra Mukherjee
90B	D. Santhanam	263B	Santosh Kumar Sen
107B	Narottambhai N. Patel	267B	Amales Kumar
116B	K. S. Rajender Rao	277B	Pradyot Kumar Banerjee
118B	Selby Giles Rozario	284B	Debidas Chakrabarti
123B	C. Subramania Sankaran	288B	Debaprasad Banerjee

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B (*contd.*)

Roll No.	Name of candidate
289B	Digendra Kumar Sen Gupta
294B	Arabinda Das
295B	N. Venugopalan
299B	Dipak Kumar Sen
300B	Asok Kumar Mitra
304B	Samaresh Roy
305B	Samiran Mitra
323B	Alokemay Bhattacharya
337B	Nimai Charan Mohanty
341B	B. R. Satyanarayana
348B	Narinder Singh
349B	Joseph Dass Ebenezer
354B	Brij Nandan Gaur
356B	Om Sarup Kapoor
358B	Jagdish Chander Bhatia
360B	Manmohan Singh Mendiratta
362B	Harbans Singh Gohlwar
363B	Prem Chandra
364B	Radheshyam Gupta
377B	Ugam Raj Mathur
383B	Jogindar Lal J. Mehandiratta
388B	Satya Pal
393B	Devi Dayal Mehta
397B	Ravi Chander Kohli
399B	Chander Mohan
401B	Shital Chandra Rai
428B	Madan Lal Gauba
433B	Satya Prakash Gangal
452B	Baldev Raj Prabhakar
458B	Jadish Lal Dhingra
459B	Ramesh Chander Bhatia
461B	Anand Krishan Avinashi
462B	Arjun Dev Hurya
463B	Surendar Mohan Mital
470B	Gyanendra Kumar Vashishtha
476B	Yash Pal Khanna
477B	Kewal Krishan Mohin
490B	Satish Kumar Chopra
497B	Madan Mohan Lal
500B	Suresh Chand Agarwal
511B	Sushil Kumar Lehri
543B	Amrik Singh
544B	Krishan Gopal Sehgal
546B	Ashwani Kumar Narula
553B	Madan Lal Bhandari
571B	Ram Singh Tak
573B	Mool Raj Mittal
607B	P. Kishan Rao
612B	Ganga Sreeramulu
622B	K. P. V. Ramanujachary
629B	G. Mallikarjuna Rao
631B	V. Venkateswara Rao
632B	M. Subbaray Achary
635B	N. Appa Rao
642B	M. Veeraiah
662B	V. Sudarshan Reddy
664B	K. V. Chenchu Rama Rao
685B	M. Raghava Rao
690B	C. Sriramamurty
691B	V. Bali Reddy
737B	Parkash Chandar Jain
739B	Vishav Mohan Bharadwaj
742B	Kewal Krishan/Singh Bhalla
748B	Satya Prakash Dixit
750B	Gyan Chand Goyal
760B	Bhopal Chand Singhvi
766B	Inder Jit
768B	Het Ram Dudi
769B	Chandra Singh Choudhary
777B	Padam Prakasha Syanghal
788B	C. Vijayasaradhi
810B	Ganga Nath
815B	Mahender Pal Singh
822B	S. K. Shrivastava
826B	Kailash Chandra Gulati
827B	Jai Narain Awasthi
821B	Mahesh Chandra Gupta
834B	Durga Dutta Mishra
838B	Suraj Prakash Juneja
848B	Sudhir Kumar Gupta
864B	Satish Chandra Kudesia
876B	P. Thankappan
880B	S. Santhanakrishnan
893B	A. P. M. Krishnamurthy
907B	K. N. Krishnamoorthy
921B	M. Koteswara Rao
928B	A. P. Jagannathan
932B	M. Sitaraman
933B	V. Ramaswami
942B	G. V. Mallikarjuna Rao

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B (*contd.*)

Roll No.	Name of candidate	Roll No.	Name of candidate
944B	C. Suryanarayana Reddy	1079B	Krishan Kumar
945B	T. Krishna Rao	1081B	S. D. Kathuria
955B	K. Suryanarayana	1082B	Yash Paul Goel
956B	Varadarajan Vittal	1095B	Mohinder Jit Singh
959B	K. C. Cherian	1100B	Narendra Kumar Aggarwal
968B	M. Krishna Murti	1124B	Devi Dayalu Gupta
972B	M. Sennava Nadi	1134B	Prabhakar V. Ghaisas
997B	P. Ramachandra Reddy	1135B	Ramachandra S. Kulkarni
999B	S. Subrahmanya Sastry	1145B	Jagannath Ganesh Oke
1011B	S. Dasaratha Ramaiah	1146B	Yashwant K. Bhagwat
1029B	Narayan Uddhav Bondre	1154B	Madhukar R. Chaudhari
1044B	Mohinder Singh Thind	1162B	Rajendra P. Jauhari
1051B	Avtar Singh Pall	1164B	Ramadas Dattatraya Kamat
1059B	Sunder Prakash	1172B	J. John Peter
1060B	Manohar Lal Anand	1173B	Krishnamurthy Rajan
1061B	Amar Nath Sethi	1183B	R. Narayanan Unnithan
1067B	Shori Lal Vinayak	1226B	R. A. Jajoo
1078B	Bal Krishan Garg	1227B	H. S. Dwarakanath

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATION WANTED

FURNACE ENGINEER, B.E.(Mech.), M. Tech.(I.I.T.), A.M.I.E., VDEh. (West Germany), trained in Germany, age 28 years, with five years' experience in design, project work, sales and administration seeks change for better prospects. (Office ref. E.S. 101)

SITUATION VACANT

TUNGABHADRA STEEL PRODUCTS LIMITED

Tungabhadra Dam

(A Joint Undertaking of the Governments of Andhra Pradesh and Mysore)

Advertisement No. 2437/B1/60

Applications are invited for the post of General Manager in Tungabhadra Steel Products Ltd

Scale of pay : Rs. 1,500-50—1,800 with free furnished quarters. Higher pay may be given to exceptionally qualified and experienced candidates.

(a) The Officer will be entitled to gratuity and other benefits as in the case of other employees of the Company.

(b) If an Officer belonging to one of the two Governments is selected, he will be given the option of resigning his permanent post in the Government service and take up this job on the above scale of pay. If he is not prepared to resign from Government service, the usual term of deputation will be applicable.

Age : Preferably below 45 years.

Qualifications and experience : Candidates must be graduates in mechanical engineering of a recognized university in India or abroad with a minimum 8 to 10 years experience in the construction, operation and maintenance of large enterprises. Candidates should possess organizing and administrative abilities and should have held managerial post and acquired sufficient experience in the management of labour and be able to solve production problems with speed and tact.

Candidates employed in Government or quasi-Government can apply through their employers together with a certificate that in the event of selection the employer shall have no objection to release them.

Applications on plain paper containing the above particulars in regard to name, address, age, date of birth, general education, technical education, experience showing details of past service and salaries drawn should reach the Secretary, Tungabhadra Steel Products Limited, Tungabhadra Dam P.O., District Bellary (Mysore) on or before the 30th March, 1962.

THE BULLETIN

OF

The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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CUTTA

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Maj.-Gen. Harkirat Singh

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Delhi
Maj.-Gen. Harkirat Singh*
T. R. Mehandru
Brig. K. B. Rai

Gujarat
T. A. Desai

Kerala
S. Varadaraja Sarma

Madhya Pradesh
S. S. Swaminathan

Madras
U. Ananda Rao
M. Ganapati

Mysore
Prof. N. S. Govinda Rao*
R. A. Rajagopal

Nagpur
R. W. Mavlankar

Orissa
S. Padhi

Poona
Brig. Arjan Singh
Brig. P. R. Kumar*

Punjab
D. C. Sharma*

Rajasthan
K. L. Mathur

Uttar Pradesh
K. N. Misra
A. C. Mitra
R. D. Varma

Coopted Members of Council

Delhi
Maj.-Gen. S. P. Vohra

Poona
G. T. Gokhale

Punjab
Balwant Singh

Secretary

B. Seshadri

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* Names repeated

STANDING COMMITTEES OF THE COUNCIL 1961-62

Finance Committee

The President

Andhra Pradesh
Dildar Husain

Assam
G. C. Goswami

Bengal
P. K. Ghosh

Bihar
K. N. Rohatgi

Bombay
N. K. Gandhi

Delhi
S. S. Kumar

Gujarat
U. N. Mahida

Jammu & Kashmir
P. N. Wanchoo

Kerala
C. S. Padmanabha Aiyar

Madhya Pradesh
Dr. V. M. Dokras

Madras
M. Ganapati

Mysore
R. A. Rajagopal

Nagpur
Y. K. Ghanekar

Orissa
S. S. Behera

Poona
Brig. P. R. Kumar

Punjab
D. C. Sharma

Rajasthan
K. N. Bhargava

Uttar Pradesh
K. N. Misra

Applications Committee

The President

Andhra Pradesh
Brig. N. Sen Gupta
C. Seshavatharam

Assam
S. P. Chaudhury
M. R. Sitaram

Bengal
B. N. Banerjee
B. N. Chaudhuri

Bihar
D. Mookerjea
G. S. Purohit

Bombay
R. N. Joshi
N. N. Purandare

Delhi
Dr. Shiv Narayan
Maj.-Gen. S. P. Vohra

Gujarat
G. S. Desai
M. M. Patel

Jammu & Kashmir

Kerala
S. Ramchandra
S. Varadaraja Sarma

Madhya Pradesh
Maj. L. R. Baronia
M. Y. Koli

Madras
Prof. P. Rajagopal Pillai
Prof. A. Srinivasan

Mysore
B. V. Patankar
C. N. Shama Rao

Nagpur
H. G. Chaoji
K. S. Ramu

Orissa
P. M. Menon
A. Shankaran

Poona
G. T. Gokhale
Dr. N. S. Nandeeswaraiya

Punjab
R. N. Chona
G. C. Khanna

Rajasthan
K. N. Bhargava
T. M. Desai

Uttar Pradesh
B. D. Goyal
S. P. Sinha

Examinations Committee

The President

K. C. Banerjee
Dildar Husain
V. G. Garde
Prof. N. S. Govinda Rao
Brig. P. R. Kumar

COMMITTEES OF LOCAL CENTRES 1961-62

Andhra Pradesh Centre

Chairman

A. Ramamurthy

Honorary Secretary

Dr. J. Purushottam

Jt. Honorary Secretary

D. Rajendra Kumar

Ex-officio Members of Committee

A. R. Venkataraman
G. A. Narasimha Rao
Guru Pershad

Members of Committee

Dildar Husain
T. Rameswara Doss
P. Narasiah
R. K. V. Narasimham
V. Pappu
R. M. Patri
Dr. J. Purushottam*
Brig. M. K. Rao
Brig. N. Sen Gupta
C. Seshavatharam
L. Venkatakrishnan

Assam Centre

Chairman

K. Barua

Honorary Secretary

B. D. Sarma

Jt. Honorary Secretary

S. P. Bondopadhya

Ex-officio Members of Committee

G. C. Goswami
H. P. Barua

Members of Committee

R. J. Batliwala
S. P. Chaudhury
Prof. N. Das Gupta
R. K. Ghosh
I. N. Hazarika
Lt.-Col. K. J. Kale
K. Mazumdar
M. Ramabrahmam
B. D. Sarma*
P. Sharma
M. R. Sitaram

Bengal Centre

Chairman

S. Bandopadhyaya

Honorary Secretary

S. K. Ghose

Jt. Honorary Secretary

K. C. Laha

Ex-officio Members of Committee

Prof. H. C. Guha
N. N. Sen Gupta
Prof. A. C. Roy

Members of Committee

P. N. Basu
A. Bhattacharyya
Dr. B. Chanda
N. N. Chakraberty
K. M. Chakravorti
S. Datta
S. K. Ghose*
K. C. Laha*
S. K. Laha
H. Nandy
S. K. Sarkar

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* Names repeated

Bihar Centre

Chairman
K. N. Rohatgi

Honorary Secretary
Dr. D. N. Singh

Jt. Honorary Secretary
Daya Sharan

Ex-officio Members of Committee

P. R. Guha
R. Sahaya
S. N. Mitra

Members of Committee

V. K. Ambast
Prof. B. Chaudhary
J. Datt
K. M. Gupta
V. S. Kulkarni
D. Mookerjea
G. S. Purohit
Dr. B. N. Roy
B. L. Singh
Dr. D. N. Singh*
S. N. Sinha

Bombay Centre

Chairman
N. K. Gandhi

Honorary Secretary
K. C. Pandya

Ex-officio Members of Committee

N. N. Purandare
K. F. Antia
S. B. Dalal

Members of Committee

R. D. V. Abreu
D. R. Bhise
J. G. Bodhe
S. H. Godbole
N. V. Joshi
R. N. Joshi
V. Y. Kamat
B. P. Kapadia
K. C. Pandya*
P. G. Patankar
R. P. Vazifdar

Delhi Centre

Chairman

S. S. Kumar

Honorary Secretary

P. R. Ahuja

Jt. Honorary Secretary

Dr. H. C. Visvesvaraya

Ex-officio Members of Committee

Brig. K. B. Ra
T. R. Mehandru
M. Hayath

Members of Committee

P. R. Ahuja*
Brig. G. R. Chainani
G. K. Chandiramani
Brig. B. N. Das
Maj.-Gen. R. A. Loomba
Brig. K. K. Rao
Dr. Shiv Narayan
Y. Venkataramiah
Dr. L. C. Verman
Dr. H. C. Visvesvaraya*
Maj.-Gen. S. P. Vohra

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* Names repeated

Gujarat Centre

Chairman
U. N. Mahida

Honorary Secretary
Dr. V. J. Jani

Ex-officio Member of Committee
T. A. Desai

Members of Committee

K. J. Bhatt
G. S. Desai
G. G. Dhanak
S. S. Divatia
Dr. V. J. Jani*
S. K. Katrak

A. P. Mehta
S. M. Mehta
M. M. Patel
O. H. Patel
A. V. Shah

Jammu & Kashmir Centre

Chairman
P. N. Wanchoo

Honorary Secretary

Ex-officio Members of Committee

P. N. Kumra

R. S. Jamwal

Members of Committee

Kerala Centre

Chairman
C. S. Padmanabha Aiyar

Honorary Secretary
K. C. Alexander

Jt. Honorary Secretary
M. P. Subramonia Ayyar

Ex-officio Members of Committee

A. O. Oommen
S. Varadaraja Sarma
S. Ramchandra

Members of Committee

K. C. Alexander*
P. K. Kuruvilla
T. P. Kuttiammu
K. R. Madhavan Nair
M. P. Mathew

V. G. G. Nayar
V. Ranganathan
K. C. Seshan
M. P. Subramonia Ayyar*

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* Names repeated

Madhya Pradesh Centre

Chairman
Dr. V. M. Dokras

Honorary Secretary
Prof. V. V. Sarwate

Jt. Honorary Secretary
M. K. R. Menon

Ex-officio Members of Committee
S. S. Swaminathan
K. R. Minocha

Members of Committee
Lt.-Col. R. L. Anand
Maj. L. R. Baronia
V. D. Gupta
M. Y. Koli
Prof. A. Lakshmanaswamy
M. K. R. Menon*
L. N. Misra
S. N. Razdan
S. Sarangapany
Prof. V. V. Sarwate*
M. L. Sood

Madras Centre

Chairman
O. T. Raghavan

Honorary Secretary
Prof. S. Panchanathan

Ex-officio Members of Committee
K. V. Ekambaram
P. S. Subramaniam
K. N. Srinivasan

Members of Committee
J. G. Abraham
U. Ananda Rao
M. Ganapati
N. Mahalingham
M. Meeran
T. Muthian
A. R. Narayana Rao
Prof. S. Panchanathan*
F. B. Pithavadian
Prof. P. Rajagopal Pillai
Prof. A. Srinivasan

Mysore Centre

Chairman
B. R. Manickam

Honorary Secretary
R. A. Rajagopal

Jt. Honorary Secretary
S. G. Ramachandra

Ex-officio Members of Committee
M. R. Arya
H. V. Narayana Rao
T. S. Narayana Rao

Members of Committee
J. G. L. D'Sa
Prof. C. Gopalakrishnan
Prof. N. S. Govinda Rao
Lt.-Col. S. P. Joga Rao
M. H. Manchigaiah
M. L. Narasimiengar
Prof. B. R. Narayana Iyengar
B. V. Patankar
R. A. Rajagopal*
S. G. Ramachandra*
E. K. Ramaswami

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* Names repeated

Nagpur Centre

Chairman

Y. K. Ghanekar

Honorary Secretary

D. G. Tamaskar

Ex-officio Members of Committee

A. de Souza
S. F. Poacha
J. C. Karkaria

Members of Committee

H. G. Chaoji
H. G. Gharpure
C. Jayavidya Charya
D. V. Joshi
S. T. Khare
Y. A. Khare
V. A. Paranjpe
K. S. Rammu
D. G. Tamaskar*
R. M. Tarkunde
K. N. Tilloo

Orissa Centre

Chairman

S. S. Behera

Honorary Secretary

S. Padhi

Jt. Honorary Secretaries

B. Mahapatra
V. Parkash
B. K. Patnaik
J. M. Patnaik

Members of Committee

R. K. Chowdhury
K. C. Das
K. C. Gantayet
Jagmohan
B. Mahapatra*
S. Mishra
S. Padhi*
V. Parkash*
B. K. Patnaik*
J. M. Patnaik*
A. Shankaran

Poona Centre

Chairman

Brig. P. R. Kumar

Honorary Secretary

D. R. Limaye

Ex-officio Members of Committee

M. L. Champhekar
D. V. Joglekar

Members of Committee

Brig. Arjan Singh
Prof. M. V. Deshpande
G. T. Gokhale
V. P. Kapur
D. R. Limaye*
A. G. Maydeo
V. G. Mehendalay
Col. R. J. Nerurkar
B. V. Raman
B. V. Ramaswamy
Col. C. Sundara Rao

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* Names repeated

Punjab Centre

Chairman
D. C. Sharma

Honorary Secretary
H. C. Sahgal

Jt. Honorary Secretary
H. C. Malhotra

Ex-officio Members of Committee

H. R. Bhatia
C. L. Handa
G. C. Khanna

Members of Committee

Balwant Singh
R. N. Chona
M. L. Jain
Jatindra Singh
S. N. Kapur
R. L. Khanna
H. C. Malhotra*
G. R. Nangea
H. C. Sahgal*
Dr. Swami Sharan
Sqn.-Ldr. Tara Singh

Rajasthan Centre

Chairman
K. N. Bhargava

Honorary Secretary
K. C. Mital

Ex-officio Members of Committee

V. G. Garde
H. Sinha
K. L. Mathur

Members of Committee

R. M. Advani
J. Dass
T. M. Desai
K. Gopinath Rao
A. Krishnamachar
B. D. Mathur
Dr. D. R. Malhotra
A. S. Mehta
K. C. Mital*
K. C. Satsangi
R. D. Singh

Uttar Pradesh Centre

Chairman
Jagdish Prasad

Honorary Secretary
K. N. Misra

Ex-officio Members of Committee

G. K. Agrawal
A. C. Mitra
H. G. Trivedi

Members of Committee

O. P. Bhasin
P. S. Bhatnagar
Prof. U. L. Chaturvedi
B. D. Goyal
P. L. Gupta
H. L. Kashyap
K. N. Misra*
Musaddi Lal
Brig. S. D. Singh
S. P. Sinha
R. D. Varma

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* Names repeated

PROCEEDINGS OF THE FORTY-SECOND ANNUAL CONVENTION CALCUTTA, FEBRUARY 3-7, 1962

The Annual General Meeting

Business Session, Saturday, February 3, 1962

The Forty-Second Annual General Meeting was held at Rabindra Smaranee, Calcutta, on Saturday, February 3, 1962, at 3.15 p.m.

About 400 members attended the Meeting, which was presided over by Maj.-Gen. Harkirat Singh, President.

1. After welcoming the delegates to the 42nd Annual General Meeting, the President took up the minutes of the 41st Annual General Meeting, circulated to all members of the Institution, *vide Bulletin*, vol. 10, no. 7, March 1961, for confirmation.

The President put the minutes to the house. Dr. V. M. Dokras (*Member*) proposed that the minutes be confirmed. Shri R. M. Patri (*Member*) seconded the proposal. This was carried unanimously.

2. The President next took up the Annual Report of the Council and the Audited Accounts for the year ended August 31, 1961, and asked if members had any comments to make.

Prof. N. S. Govinda Rao (*Member*) proposed that the Annual Report be adopted and the Audited Accounts be approved. Shri T. R. Mehandru (*Member*) seconded the proposal. This was carried unanimously.

3. The President then announced that he had been re-elected as President for 1961-62. (*Applause*)

The President then read the report of the Council regarding the elections for 1961-62 of (i) The Vice-Presidents, (ii) The Sectional Chairmen, and (iii) New members of the Council as follows :

(i) The following members by virtue of their having been elected Chairmen of Local Centres become Vice-Presidents of the Council under paragraph 6(d) of the Royal Charter :

Andhra Pradesh Centre	A. Ramamurthy
Assam Centre	K. Barua
Bengal Centre	S. Bandopadhyaya
Bihar Centre	K. N. Rohatgi
Bombay Centre	N. K. Gandhi
Delhi Centre	S. S. Kumar
Gujarat Centre	U. N. Mahida
Jammu and Kashmir Centre	P. N. Wanchoo
Kerala Centre	C. S. Padmanabha Aiyar
Madhya Pradesh Centre	Dr. V. M. Dokras
Madras Centre	O. T. Raghavan
Mysore Centre	B. R. Manickam

Nagpur Centre	Y. K. Ghanekar
Orissa Centre	S. S. Behera
Poona Centre	Brig. P. R. Kumar
Punjab Centre	D. C. Sharma
Rajasthan Centre	K. N. Bhargava
Uttar Pradesh Centre	Jagdish Prasad

(ii) The following members have been elected Sectional Chairmen under Bye-Law 29 :

Civil Engineering Section	Prof. N. S. Govinda Rao
Mechanical Engineering Section	T. R. Gupta
Electrical Engineering Section	Prof. M. V. Deshpande
General Engineering Section	R. N. Joshi

The following members have been elected Members of Council by Local Centres to fill vacancies under Bye-Law 27 :

Andhra Pradesh Centre	G. A. Narasimha Rao
Assam Centre	G. C. Goswami
Bengal Centre	Dr. T. Sen
	Prof. D. Banerjee
Bihar Centre	J. Datt
Bombay Centre	V. Y. Kamat
	N. N. Purandare
	B. P. Kapadia
Kerala Centre	S. Varadaraja Sarma
Madras Centre	M. Ganapati
Mysore Centre	R. A. Rajagopal
Orissa Centre	S. Padhi
Poona Centre	Brig. Arjan Singh

The following Past-Presidents become *ex-officio* Members of Council under Bye-Law 50 :

Dr. M. S. Thacker
Shri Kanwar Sain
Shri D. P. R. Cassad
Dr. K. L. Rao

4. Shri K. C. Banerjee (*Member*) proposed that Messrs. Price, Waterhouse, Peat & Co. be reappointed Auditors of the Institution for the year 1961-62 on a remuneration of Rs. 3,000 per annum. This was seconded by Shri S. Varadaraja Sarma (*Member*) and was carried unanimously.

5. Shri Dildar Husain (*Member*) asked for the permission of the Chair to speak on a proposal for raising the annual subscriptions, entrance fees, transfer fees, and registration fees. He traced the rapid development of the Institution membership and its

activities, particularly over the last two or three years, and asked the house to support the proposal for raising the annual subscriptions and other fees as proposed in order that the Institution may discharge its greatly increased responsibilities in a proper manner.

Others who took part in the discussion that followed were : Sarvashri N. V. Modak (*Member*), K. F. Antia (*Member*), S. Bandopadhyaya (*Member*), A. Ramamurthy (*Member*) and Dr. T. Sen (*Member*).

The President then put to the house that it seemed to be the sense of the house that while the principle of raising the annual subscriptions and other fees was accepted, the proposals in this respect should be circulated in advance to all Corporate Members for their information and study. He, therefore, said that the necessary arrangements for this would be made, and an Extraordinary General Meeting of Corporate Members called for the revision of annual subscriptions and other fees.

The General Body resolved that the principle of revision of annual subscriptions, entrance fees, transfer fees, and registration fees be accepted and that the actual amounts of subscriptions and other fees be further considered at an Extraordinary General Meeting to be called for this purpose at a place fixed by the President. (*Applause*)

With a vote of thanks to the Chair, the Business Session terminated at 5.00 p.m.

Inaugural Session, Sunday, February 4, 1962

The Inaugural Session was held in Rabindra Smaranee, Calcutta, at 9.00 a.m. Over 1,200 members and guests attended the Session.

Dr. B. C. Roy, Chief Minister of West Bengal, inaugurated the Session. He arrived at Rabindra Smaranee at 8.50 a.m. and was received by the President, Maj.-Gen. Harkirat Singh, Dr. T. Sen, Chairman of the Reception Committee of the Bengal Centre, and Shri S. Bandopadhyaya, Chairman of the Bengal Centre, and introduced to the Past-Presidents and members of the Council for 1961-62. A group photograph was taken of the Council with Dr. Roy.

Messages for a successful Convention were received from the following :

The Engineering Institute of Canada ; The Institution of Electrical Engineers, London ; The South African Institution of Civil Engineers ; The South African Institute of Electrical Engineers ; Societé Royale Belge des Ingénieurs et des Industriels ; and Verein Deutscher Ingenieure.

1. Dr. T. Sen, Chairman of the Reception Committee, welcomed the delegates in Calcutta as follows :

Dr. Roy, distinguished Guests, Ladies and Gentlemen,

'It is my pleasure and privilege this morning to welcome you all to this, the Forty-second Annual Session of the Institution.

I feel highly honoured in being called upon to welcome Dr. Roy who has been gracious enough to accept our invitation to inaugurate the Annual Session which is being held in Calcutta, the capital of the State, of which he is the able steward.

In conformity with the time-honoured custom of such occasions, I would briefly refer to the strides this Institution has been making and to its great contribution in the service of the nation during the last four decades.

The Institution has now 18 Local Centres spread over all the States of India, including Jammu and Kashmir, and a membership of over 32,000. It covers all branches of engineering, technical education, and engineering research. Its members are managing the execution of almost all the major development projects of irrigation, power, steel plants, heavy and medium industries, railways, roads, communications, oil exploration, oil refineries, atomic energy programmes, etc. They are represented on the various scientific and industrial panels, and on councils and committees dealing with technical education and institutions and other engineering activities.

This Institution has made a worthwhile contribution in increasing the output of engineers at a crucial stage in our Five Year Plans through 'earn and learn' programmes and a well planned system of examinations. The major objective of the Institution is the promotion and pooling of engineering knowledge with a view to developing research and providing experts in all branches of engineering for the purposes of investigation, planning, design, construction and operation, and thereby making Indian engineering and industry mostly independent of foreign consultants and experts.

The engineers of today and tomorrow have to be equipped to meet the challenge of nuclear advances, rocketry, and the space age. Also, they have to be more creative and self-reliant, so that the implementation of our development projects may no longer have to develop on imported knowhow, research and equipment. We have to be serviced by Indian talent and research and Indian equipment. For securing that class of engineers, we have completely reoriented our curricula of studies with a strong bias on the basic sciences and research.

You, Dr. Roy, have been the mainspring of all the major development projects and the phenomenal engineering activity connected with them in the State. The Institution looks upon you for guidance and support in the fulfilment of its mission of efficient and effective service to the nation. On behalf of the Institution and myself, I have to thank you, Sir, for graciously coming to inaugurate this session. I have also to thank all our guests for their kind presence amongst us today.

I crave the indulgence of our guests who have come from other States, to address to them in particular a few words in the context of a small incident. While coming back from Asansol on 23rd January, where I had gone to address the Rotary Club, the Punjab Mail by which I was travelling came to be detained for some time at Rishra, a station 16 km. from Howrah, due to some trouble in the signalling system. My four fellow passangers in the compartment hailing from other States got nervous and enquired of the steward if there had been some political demonstration in Calcutta. The steward tried to explain that he had no knowledge as Calcutta was some 16 km. away but the gentlemen enquired if the train had not already come within the State of West Bengal. I was brought to a pointed and painful realization of the fact that some people, both here and outside, regard West Bengal as a naughty, nasty and troublesome child perpetually grumbling and whining, and are prepared to write it off as a hopeless case. They feel that West Bengal had not yet learnt the national style of politics, if any such thing has come into existence. True, on the surface, West Bengal seems to be caught up in an endless whirl of agitation and demonstration, driving both the men in power and the masses of helpless people to distraction and a feeling of bitter frustration. I would, however, ask if it would not be fair, before trying to fix the blame upon the Bengali for his allegedly incorrigible restlessness and vehemence, to look at some of these stubborn facts about West Bengal in the proper historical perspective.

West Bengal is the second smallest State of the Indian Union, with a density of population only next to that of Kerala. Calcutta alone has to bear the weight of about a fifth of the total population of the State. Calcutta, even in the best of times, was no better than a chance-erected and chance-directed city.

Frustration, economic unbalance, and consequent growth of callous indifference together with the sudden and sweeping changes brought about by partition, have made Calcutta what it is today. No other city in India or elsewhere, with the exception of Stalingrad or Berlin during the War, has suffered so much and borne so many gaping wounds as Calcutta has. The moral muddle of the war years, the first influx of refugees from Burma, the terrible famine of 1943, the great killing of 1946, and then, the never-ending stream of displaced persons from East Pakistan, have rendered West Bengal's equilibrium chronically unstable. The Hooghly is dying, and none knows who is going to save Calcutta and the lower reaches of the delta from being turned into a saline swamp. The plight of West Bengal, with a swelling and seething mass of jobless and homeless people, is like that of England in the hungry forties of the last century. This little historical parallel should be able to induce some tolerance in those who are too ready to accuse West Bengal of being perverse without purpose, impatient without any cause. With some 1,200,000 jobless and about 3,000,000 displaced persons, politics in the State is bound to be perpetually simmering and boiling over.

The average Bengali has generally, since the early *swadeshi* days, a zest for politics. If now the politically conscious Bengali finds that everything in the homeland has gone topsy-turvy since independence and partition, he cannot, in fairness, be condemned as an incorrigible malcontent. Enthusiasm for the past, that once seemed to be tremendously promising, now haunts West Bengal in a manner that cannot be felt anywhere else in India; and the creeping menace of a suffocating and hopeless existence in a small and overcrowded State aggravates the bitter sense of disappointment. In every aspect of life, West Bengal, which more than any other State was in the forefront of the revolutionary movement, which gave birth to Raja Rammohan Roy, Swami Vivekananda, Rabindranath Tagore, Dr. Nil Ratan Sarkar, Acharya Prafulla Chandra Ray, Acharya Jagadish Chandra Bose, Netaji Subhash Chandra Bose, and others of hallowed memory, expected changes promised by the national leaders, which not only remain unfulfilled, but, have little chance of ever being fulfilled. This is the clue to West Bengal's political malaise.

This, in a nutshell, is the problem of the so-called problem Province. I would request the guests from other States to kindly try to understand the Bengalis and the State of West Bengal with sympathy, imagination and understanding.

I extend a cordial welcome to you all.'

2. Dr. M. S. Thacker, Past-President, introduced Maj.-Gen. Harkirat Singh, President-Elect for 1961-62, in suitable terms.

3. Maj.-Gen. Harkirat Singh then delivered the Presidential Address (see page 25).

4. Dr. B. C. Roy, Chief Minister of West Bengal, then delivered the Inaugural Address.

He said, 'The country has undertaken various development projects and the Government should take advantage of the engineering profession in the execution of these projects. The profession of engineering is based on two factors—scientific and empirical. In this fast changing world, it is to be seen to what extent the engineering profession could blend these factors and alter its methods with the changing circumstances. Engineers have an important role in the implementation of our plans. Their suggestions would be of great value and their services would be essential for the development of the country.'

Narrating how he missed being an engineer, Dr. Roy said, 'After graduating in mathematics 60 years ago, I applied for admission to the Bengal Engineering College as well as to the Medical College. At about 10 a.m. on the day I took my admission in the Medical College, I received a letter from the College authorities approving my admission and asking me to deposit money within 12 noon on the same day, and I did so. Four hours later, a letter came from the B.E. College authorities approving my admission in that College too. But by then, I had sealed my fate to be a medical man. But for this space of these four hours, I may have become an engineer.'

Dr. Roy continued, 'The engineering profession should, with regard to production or establishment of new units, take into consideration the needs of the people. The engineers, whenever they plan or design any project, should not forget the people who are going to use it or who are going to derive benefit from it. The work of the engineers should not end merely in laying on paper the plan or design of a particular engineering work; in its execution, they should also consider how it can be best suited to the individuals or group of persons for whom it is meant. The projects should not be designed purely on a scientific basis but should be moulded to suit the people. I am aware that sometimes administrators and men with money try to dictate the progress of the work but it is for the engineers to point out the defects and tell them whether it would suit the people or not. The engineers should consider themselves as part of the society which they should serve not only with their technical skill but also with their mental and moral sense. They should also see that their wisdom is not prostituted for works which should have been avoided, because while the science is developing fast, its moral value has not been properly considered by the engineers. The wisdom of engineers in some countries has been utilized for certain purposes which should have been avoided.'

Speaking on the role of the Institution, he said, 'The Institution of Engineers, which has taken upon itself the training of engineers, should follow the path which would help in the realization of the responsibilities of the engineers in this matter.'

5. Maj.-Gen. Harkirat Singh, President, announced the award of the following prizes by the Council and the Trustees of the Public Charitable Trust for the Advancement of Engineering Education respectively :

The Council of the Institution have awarded the following prizes for the year 1959-60:

(1) The President of India's Prize for the best paper in Hindi to Shri Vishwambar Prasad (*A.M.*) for his paper 'Problems in Villages: (i) Housing, and (ii) Sewage Disposal'.

(2) An Union Ministry of Irrigation and Power Gold Medal and Cash Award to Shri M. Hayath (*M.*) for his paper 'Power Projects'.

(3) An Institution Prize to Shri C. L. N. Iyengar (*A.M.*) for his paper 'Evaluation of Rigid Pavement Performance with Special Reference to Airports'.

(4) An Institution Prize to Sarvashri N. Majumdar (*A.M.*), T. B. S. Prakasam (*Non-member*) and M. V. Suryaprakasam (*A.M.*) for the paper 'A Critical Study of Septic Tank Performance in Rural Areas'.

The Trustees of the Public Charitable Trust for the Advancement of Engineering Education have awarded the following prizes:

(1) Prizes to commemorate the inauguration of the 40th Annual General Meeting at Delhi by the Prime Minister of India:

Mechanical Engineering ..	Sarvashri V. L. N. Row (*M.*) and K. Vepa (*Non-member*) for their essay 'Dimensioning in Interchangeable Manufacture'
Electrical Engineering ..	Shri S. S. Murthy (*A.M.*) for his essay 'Modern Trends in Construction and Maintenance of Transmission Lines'
General Engineering ..	Prof. R. M. Advani (*M.*) and Shri P. C. Chakravarti (*M.*) for their essay 'Educating the Engineer of the Future'
Mining and Metallurgy ..	Shri S. Sarwal (*M.*) for his essay 'Oil Exploration in India'
Chemical Engineering ..	Shri A. K. Shaha (*M.*) for his essay 'Utilization of Low Grade Fuels'

(2) The Shrimati B. P. Byramji Gold Medal to Shri K. R. Balakrishnan (*Student*) for securing the highest number of marks in Sections A and B of the Associate Membership Examination during 1960-61.

(3) The D. P. R. Cassad Gold Medal to Shri O. O. D. Oliveira (*Student*) for his paper 'Aluminium in Electrical Industry'.

(4) The Shrimati Saroma Devi Sanyal Memorial Prize to Shri R. Pitchai (*A.M.*) for his paper 'Capacity of Streams to Assimilate Organic Pollution: a Development from First Principles'.

As the prizes were announced by the President, the presentations were made by Dr. Roy to the respective recipients. Sarvashri N. Majumdar, Vishwambhar Prasad and S. Sarwal received their prizes in person. The other prize winners were not present.

6. Shri S. Bandopadhyaya, Chairman, Bengal Centre, proposed a vote of thanks to the Chief Guest, the Chief Minister of West Bengal, in suitabe terms.

The National Anthem was then played, and Dr. Roy left the meeting at 10.30 a.m. for a Tea given in his honour in the grounds of Rabindra Smaranee.

Closing Session, Wednesday, February 7, 1962

The Business Session of the 42nd Annual General Meeting adjourned from February 4, 1962, was held at 2.30 p.m. on February 7, 1962, at Rabindra Smaranee, Calcutta. The President, Maj.-Gen. Harkirat Singh, was in the Chair.

6. At the request of the President, brief reports of the technical sessions held in the various Divisions and Groups were presented by the respective Chairmen.

(i) Prof. M. V. Deshpande (*M.*), Chairman, Electrical Engineering Division, said that a large number of members took part in the Paper Meetings and the Symposium on 'Power Supply in India' held in this Division. However, the hall allocated for meetings was somewhat inadequate, with the result that some of the members had to stand during the proceedings. The discussions during the Paper Meetings and the Symposium were of high standard and evoked considerable interest. The Symposium brought out various aspects of power supply in India with particular reference to load forecasting, tariffs, and planning and management. In regard to the future activities of the Division, it would be necessary for members to take active interest and write papers of requisite standard in keeping with the status of the *Journal*. He expressed his confidence that the necessary interest would be forthcoming.

(ii) Shri R. N. Joshi (*M.*), Chairman, General Engineering Division, said that the proceedings in his Division started with the Chairman's Address in which the chemistry, properties, manufacture and applications of polyvinyl chloride were described. This was followed by Paper Meetings when there was considerable discussion. In the Symposium on 'Anatomy of Slums', a number of interesting papers were presented and discussed, dealing with the origin, existence, effects and clearance of slums in general, and with Calcutta in particular. Based on this discussion, it could be said that the solution to the problem of slums demanded planned regional development, educating the population on the advantages of clean living, and the making of cheap building materials for rehousing slum dwellers. Shri Joshi suggested that a committee may be formed to study the problem of slums in the country.

(iii) Dr. V. M. Dokras (*M.*), Chairman, Chemical Engineering Division, said that the papers and discussion in the General Engineering Division covered a part of the scope of this Division also. The subject of the Symposium, 'Utilization of Industrial Wastes', was important in view of the large scale industrialization in the country and the resulting large quantities of dangerous wastes. The paper on 'Biochemical Utilization of Spent Distilling Liquor' pointed out that spent distilling liquor should not be discharged into rivers and streams without proper treatment, as it takes oxygen from water, killing fish and other living organisms in it. There was good deal of discussion on the paper.

(iv) Shri R. S. Mehta (*M.*), Chairman, Public Health Engineering Group, said that the Paper Meetings in the Group were very successful from the points of view of both attendance and technical value. Shri K. B. Carnac, the retiring Chairman, could not attend the session, and his note giving a summary of the activities of the Group during the previous year was read. This was followed by the Chairman's Address in which many aspects of public health engineering were highlighted with particular reference to water conservation for drinking and industrial uses and the need for a River Pollution Act. Then there was a talk by Shri N. V. Modak in which he outlined the trends of research work in public health engineering in the U.S.A. and Europe. Prof. H. Babbit then spoke on public health engineering practices in the U.S.A. Three papers were discussed in the Paper Meetings. The last item for discussion was the 'Tentative Design Standards for Sewage Works' proposed by the Group. A number of recommendations were made and some resolutions were passed.

(v) Shri R. M. Patri (*M.*), Chairman, Industrial Management and Production Engineering Group, said that the name of the Industrial Engineering and Production Engineering Group should be changed to Industrial Engineering Group. The attendance at the Paper Meetings was not large. The Chairman's Address brought out the importance of plant layout and planning for higher productivity. Shri S. J. Jain of the National Productivity Council then gave a talk on the role of the industrial engineer in management. Four papers were discussed, including a paper by Prof. R. D. Singh, which was originally scheduled for the Mining and Metallurgy Division.

(vi) Shri N. N. Purandare (*M.*), Chairman, Structures Group 1—Prestressed Concrete, said that the Paper Meetings in the Group were held jointly, first, with the Civil Engineering Division, and then with the Structures Group 2—Shell Structures. The Chairman's Address dealt with new techniques in prestressed concrete work and their suitability for highways, bridges, etc. Two papers were presented and discussed, one dealing with prestressed concrete portal frames and the other with developments in the use of prestressed concrete. Shri Purandare felt that the Paper Meetings in this Group should be held either in continuation of the Paper Meetings in the Civil Engineering Division, or, so arranged as not to be simultaneous with them in order that all civil engineers interested in prestressed concrete could attend the discussions in the Group.

(vii) Shri G. S. Ramaswamy (*M.*), Chairman, Structures Group 2—Shell Structures, said that this was the first meeting of the Shell Structures Group, and it was well attended. The Chairman's Address gave a review of the developments in shell structures in India and abroad with regard to design, construction, research and standardization, and outlined the work done at the Central Building Research Institute, Roorkee, in this field. Four papers were presented and discussed. This was followed by a discussion on the future programme of the Group, and it was decided to issue a newsletter every six months which would include reviews of books and publications connected with shell structures. Shri Ramaswami suggested that suitable prizes may be offered by the Institution to stimulate work in this field.

(viii) Dr. M. N. Dastur (*M.*), Chairman, Mining and Metallurgy Division, said that Chairman's Address indicated the present trends in the production of iron and steel. This was followed by discussion on two papers by Shri U. P. Mullick, presented for the Symposium on 'Mine Mechanization' and 'Development of Non-Ferrous Metals and Alloys During the Third Five Year Plan', one dealing with shaft winding equipment in collieries and the other describing important non-ferrous alloys and the economics of their production in India. The Chairman added that the Division would try to give a better performance next year and increase the membership of the Division.

(ix) Shri T. R. Gupta (*M.*), Chairman, Mechanical Engineering Division, said that the Paper Meetings and the Symposium on February 5 and 6 had a large attendance. The papers presented were of a high standard and led to interesting and useful discussion. The Symposium papers and the discussions which followed showed the high quality of research work being done in the field of machine tools and metal cutting, and indicated the vast scope for development and research in this field. The time available for the meetings was however inadequate. He suggested that efforts should be made to further improve the technical activities of the Division by publishing papers of high standard.

(x) Prof. N. S. Govinda Rao (*M.*), Chairman, Civil Engineering Division, said that the attendance at the Paper Meetings and Symposium on February 5 and 6 was large and the discussion lively. He said many valuable thoughts were expressed on the problem of floods and Shri Kanwar Sain's presence during the discussions was a fortunate one. He suggested that more symposia on other aspects of civil engineering should be held to step up the technical activities of the Institution, and added that the Paper Meetings must be so phased in the programme that there is no clash between the Paper Meetings in associated Divisions and Groups. He further said that it would be worth having the technical sessions for three days, followed by engineering visits.

(xi) Shri S. Basu, (*M.*), Chairman, Marine Engineering and Shipbuilding Group, said that the Paper Meetings in this Group were held jointly with the Nuclear Engineering Group. The meetings were well attended. Three papers in the Marine Engineering and Shipbuiding Group and one in the Nuclear Engineering Group were presented and discussed. Prof. J. C. Georgian's paper dealt with fuel economy in marine Diesel engines utilizing waste heat. The paper was illustrated with slides. Shri T. K. T. Srisailan described the duties of marine engineers, and the essentials of their training. The paper by Shri S. K. Biswas was accompanied by slides showing the various phases of construction of a nuclear power plant.

The President then invited Prof. R. N. Banerjee (*M.*), Chairman, Students Session, to summarize the proceedings in the Students Session.

Prof. Banerjee said that Students Session was held in two sittings, each lasting about 2½ hours. About 75 students were present. Prof. M. V. Deshpande gave a talk on how to write technical papers. This was followed by the presentation of papers by three Students. Prof. Banerjee suggested that a sub-committee may be formed by the Council to look after the interests of the Students. This was followed by a talk by Shri S. Bandopadhyaya, Chairman, Bengal Centre.

7. The President then addressed the delegates and expressed his gratification at the number of papers contributed to the various Symposia and at the high quality of discussion in the Paper Meetings and the Symposia. He made particular reference to the progress made by the Public Health Engineering Group, and said that the time had perhaps come when the Group needed to be raised to the status of a Division.

Speaking of the increasing enthusiasm with which the Paper Meetings were being attended, the President said that the time allotted for the technical sessions seemed inadequate. He said that this feeling had also been expressed at an informal meeting of the Division and Group Chairmen which had been held the previous day. He was of the opinion that it might be necessary to have three full days for the technical sessions alone, and said that this matter would be discussed at the next meeting of the Council.

The President then referred to the new scheme of examinations in which Students would be able to appear in specific groups, based on the new set-up of the technical Divisions in the Institution. The framing of the syllabuses and associated work had taken a considerable amount of time to complete and had been put in final shape towards the end of last year. The main object of grouping the subjects Divisionwise was to enable the Students who passed the Institution examinations to receive certification in their particular branches of engineering, in order to satisfy prospective employers that a Student was qualified in that branch. The new scheme also enlarged the scope of the examinations, raising the standard a little bit higher than it was now. But it was essential that the Institution kept a very high standard of examinations, as Sections A and B formed the yardstick by which the standards of other engineering examinations were measured.

The President then referred to the revised scheme of publications. The *Journal*, he said, which was previously being published in two Parts, was divided into seven Parts, each Part corresponding to a technical Division of the Institution. Some of these Parts were being published six times a year and the others thrice a year. This considerably expanded the scope of the publications, and also effected financial savings which were being ploughed back for the printing of more papers. He announced that almost all the backlog of papers had now been cleared, and the factual position today was that in some of the Divisions there were no papers awaiting publication. He was certain that the new Division and Group Chairmen would further increase the technical activities in their respective Divisions and Groups, and hoped more papers would be forthcoming during the coming year. He also said that any increase in revenue from advertisements would materially help to further increase the volume of publications.

The President then referred to the reorganization of the Institution establishment which had been carried out during the preceding year. The establishment had been reoriented for the rapidly increasing membership and volume of work. He said that any member who paid a visit to the Headquarters Office would see graphs displayed there which showed an almost perpendicular rise in every phase of Institution activity.

The President then spoke of the building activities at the Local Centres. He said that a number of them had their buildings already—Andhra Pradesh, Delhi, Kerala, Madras, Nagpur and Uttar Pradesh. All the other Local Centres were in the process of securing land or starting construction. The Government of Jammu and Kashmir had granted two plots of land, one at Srinagar for the Jammu and Kashmir Centre, and the other at Jammu for the Jammu Sub-Centre. The foundation stone for the Srinagar building had already been laid by the Prime Minister of Jammu and Kashmir. In Punjab, the foundation stone of the Punjab Centre building had also been laid by the Chief Minister of Punjab at Chandigarh.

He then said that the final decision had been taken by the Council during the Convention for the construction of a ten-storeyed building for the Headquarters at Calcutta. This would provide badly needed floor space for both the Headquarters Office and the office of the Bengal Centre. Both these offices were working under severe stress of space. It was expected that the construction of the new building as also additions to the existing building would soon be commenced. He said that he had been assured by senior members in Bengal that collection of the necessary money for this building would not pose a problem.

Apart from these building programmes, the President said that the Council's plans for the ensuing year included a considerable stepping-up of the technical activities. He referred to an informal meeting of the Division and Group Chairmen which had been held the previous day.

An event of outstanding importance during the previous year had been the holding of the Symposium on 'Economy and Efficiency of Engineering Enterprises in India' in New Delhi in November. The President traced how this was a natural outcome of the thoughts expressed in his Presidential Address delivered at Bombay a year ago. The Symposium was an outstanding success, and the attendance was a record for any technical symposium held in this country. The main issue brought out by the Symposium was the fact that the management of large industrial and engineering undertakings in this country, which was vested with the administrative services, had by and large failed. The engineers who had attended the Symposium, many of them very senior men and at the top of their profession, were unanimous in the view that unless the whole set-up was quickly changed, the targets set by our Five-Year Plans were not likely to be successfully attained.

The President then said that improved finances were inseparable from improved activities. He referred to the discussion at the Business Session on 3rd February in regard to the proposal to raise the annual subscriptions, which was the main source of income of the Institution. He also referred to the fact that the subscriptions were last revised almost exactly ten years ago. Since that time, costs had gone up greatly, and it was very essential that the Institution's revenue should be augmented, without which it was not going to be possible to carry out the planned programmes. He said that as agreed by the General Body at the Business Session he would now take steps to call an Extraordinary General Meeting of Corporate Members for discussing this proposal.

The President said that the Council had also decided to establish a Benevolent Fund of the Institution to assist members and their families in distress. Such funds existed in other great engineering societies of the world. He thought that this Fund might take shape by the allocation of Re. 1 per member per year from the annual subscriptions of members. He gave an example as to how this Fund would function. Last year an application for assistance was received from a very senior member of the Institution from Nagpur, who was in extremely distressed family circumstances following the murder of his son and his own permanent disablement from serious ailment. The Council sanctioned a grant of Rs. 1,000 and decided to review the matter on the formation of the Benevolent Fund. But as the Fund had not yet taken shape, the Council decided during the Convention to further sanction an amount of Rs. 100 per month

42ND ANNUAL GENERAL MEETING, CALCUTTA, FEBRUARY 1962

THE COUNCIL 1961-62

Sitting : (L. to R.) R. N. Joshi T. R Mahandru Dildar Husain N. V. Modak S. Bandopadhyaya Dr. M. S. Thacker Maj.-Gen. Harkirat Singh (*President*) Dr. B. C. Roy (*Chief Minister, West Bengal, Chief Guest*) Dr. T. Sen Sir L. P. Misra N. K. Mitra Prof. N. S. Govinda Rao Prof. M. V. Deshpande B. Seshadri (*Secretary*)

Standing: Front Row (L. to R.) Prof. R. N. Banerjee K. N. Rohatgi Prof. D. Banerjee T. R. Gupta P. K. Ghosh Dr. V. M. Dokras N. N. Purandare O. T. Raghavan V Y. Kamat N. K. Gandhi K. C. Banerjee U. Ananda Rao Prof. H. C. Guha

Standing: Back Row (L. to R.) Brig. Arjan Singh B. P. Manickam U. N. Mahida Brig. P. R. Kumar R. W. Mavlankar S. Varadaraja Sarma B. P. Kapadia

42ND ANNUAL GENERAL MEETING, CALCUTTA, FEBRUARY 1962

HEADQUARTERS BUILDING OF THE INSTITUTION, CALCUTTA

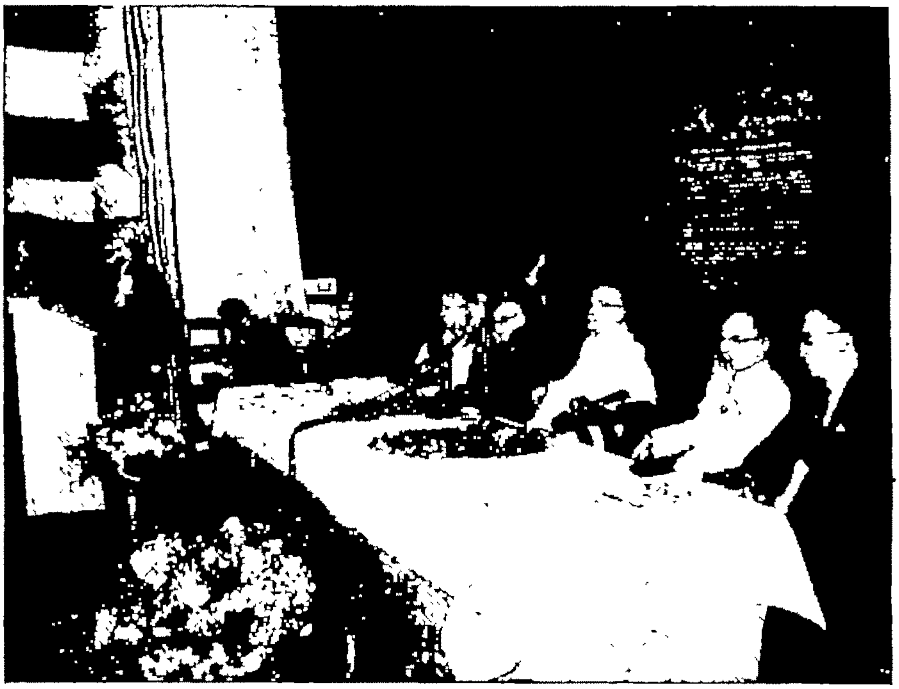
MAJ.-GEN. HARKIRAT SINGH, PRESIDENT 1961-62, BEING INTRODUCED TO DR. B. C. ROY

42ND ANNUAL GENERAL MEETING, CALCUTTA, FEBRUARY 1962

Dr. T. Sen Welcoming The Gathering

Dr. M. S. Thacker Introducing Maj.-Gen. Harkirat Singh to the Gathering

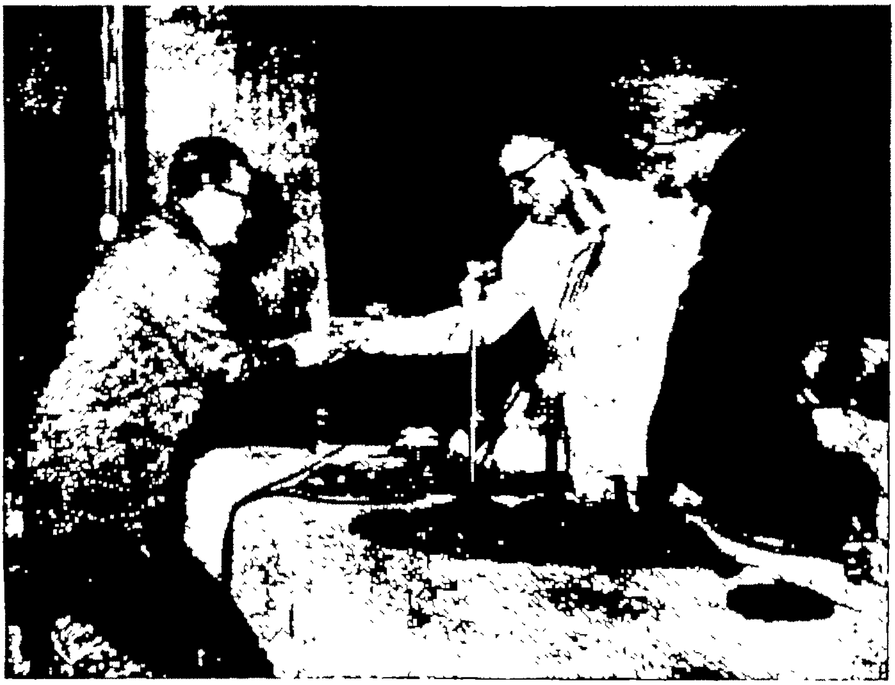
42ND ANNUAL GENERAL MEETING, CALCUTTA, FEBRUARY 1962



MAJ.-GEN. HARKIRAT SINGH DELIVERING THE PRESIDENTIAL ADDRESS

DR. B. C. ROY DELIVERING THE INAUGURAL ADDRESS

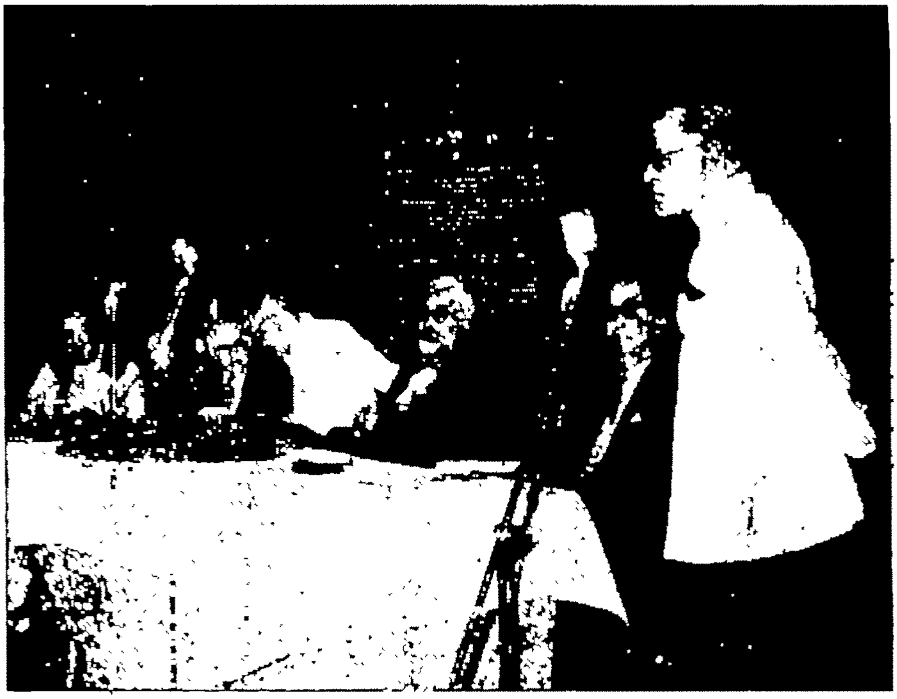
42ND ANNUAL GENERAL MEETING, CALCUTTA, FEBRUARY 1962



Shri N. Majumdar (*A.M.*) Receiving an Institution Prize

Shri S. Sarwal (*M.*) Receiving a Public Charitable Trust for Advancement of

42ND ANNUAL GENERAL MEETING, CALCUTTA, FEBRUARY 1962



Shri S. Bandopadhyay Proposing a Vote of Thanks to Dr. B. C. Roy, Chief Guest

Shri A. K. Sen Replying to the Toast to the Chief Guest at the Annual Dinner

42ND ANNUAL GENERAL MEETING, CALCUTTA, FEBRUARY 1962

DR. M. S. THACKER DELIVERING THE FIFTH SIR M. VISVESVARAYA LECTURE to this member to alleviate his distress. The President said that even before the Institution extended this help, the member was already receiving monthly relief from two of the British Institutions.

The President continued that similar to the Benevolent Fund the finances of the Public Charitable Trust for the Advancement of Engineering Education also needed to be augmented. He thought that the allocation of Re. 1 per member per year might enable the creation of a number of scholarships for Students who wished to pursue engineering study and who were in need of financial help.

The President concluded as follows :

'I have now the very pleasant duty of extending our warmest thanks to the Bengal Centre for acting as hosts on this occasion and for their unbounded hospitality during the last few days. I wish particularly to mention the names of Dr. T. Sen, Chairman of the Reception Committee, and Shri S. Bandopadhyaya, Chairman of the Bengal Centre, in this connection. It was under their inspiration and guidance that the work of organizing the Convention had proceeded. Our thanks are also due to the members of the Committee of the Bengal Centre, the members of the Reception Committee, and members of the various Sub-Committees who were responsible for organizing the Paper Meetings, the Symposia, transport, local visits, outstation tours, etc.

I have also to extend our thanks to the Mayor of Calcutta for his very pleasant At Home on the 3rd and the staff of the Calcutta Corporation for help in decoration work. Our thanks are also due to the following for lunches during the Convention : Sen-Raleigh Industries of India Ltd.; National Rubber Manufacturers Ltd.; Shri D. N. Bhattacherjee ; Shalimar Tar Products (1935) Ltd.; Braithwaite & Co. (India) Ltd.; and H. N. Electricals.

I must thank Electrical Machines Corporation (P) Ltd. for presenting the Cultural Show on 3rd February, and Dalmiya & Co. for assistance in making arrangements at Rabindra Smaranee.

Our thanks are also due to the following for lunches and teas given to the delegates during local visits :

Commissioners for the Port of Calcutta ; Jadavpur University ; Indian Oxygen Ltd.; Indian Statistical Institute ; Bengal Waterproof Works, (1940), Ltd. ; Jay Engineering Works Ltd. ; School of Printing Technology, Jadavpur ; Ramakrishna Mission, Narendrapur ; Guest, Keen, Williams, Ltd.; Bengal Engineering College, Sibpur ; The Dunlop Rubber Co. (India) Ltd.; Tribeni Tissues Ltd.; Bata Shoe Co. (P) Ltd.; Birla Brothers Ltd.; Jessop & Co. Ltd.; The Trustees of Pareshnath Jain Temple ; National Insulated Cable Co. of India, Ltd.; River Research Institute ; The Metal Box Co. of India Ltd.; Shalimar Tar Products (1935) Ltd.; The Alkali & Chemical Corporation of (I) Ltd.; National Rubber Manufacturers Ltd.; and Indian Aluminium Co., Ltd.

I have also to thank the Education Directorate of the Government of West Bengal for making available this building, Rabindra Smaranee, for our Annual Convention, and the Home and Publicity Directorate for the use of the Calcutta Information Centre ; and the authorities of the Academy of Fine Arts and Shri J. N. Majumdar for kindly making a part of his residence available for Paper Meetings.

Our thanks are also due to Apeejay-Surendra for presenting the folder in which the convention papers were distributed to the delegates and for the ladies wallet; and Bharat Electrical Industries Ltd. for the presentation of writing pads to the delegates.

I must also thank the following for placing cars at the disposal of the delegates: Indian Oxygen Ltd.; William Jacks & Co. Ltd.; Guest, Keen, Williams, Ltd.; Siemens Engineering and Manufcturing Co. of India Ltd.; Simon Carves; Jay Engineering Works Ltd.; Bridge & Roof Co. (India), Ltd.; Shalimar Tar Products (1935) Ltd.; Braithwaite, Burn & Jessop Construction Co., Ltd.; Durgapur Industries Ltd.; Bhartia Electric Steel Co., Ltd.; The West Bengal State Electricity Board; West Bengal Development Corporation; and the West Bengal Construction Board.

During the outstation visits which will commence tomorrow, many facilities for the visiting delegates will be extended by the authorities of the Damodar Valley Corporation and A.V.B. Ltd., Durgapur. I would also like to thank them in advance for these courtesies.

In conclusion, I would like to extend my thanks to the volunteers who were responsible for arranging many of the details for the Convention.'

With a vote of thanks to the Chair, the Session concluded at 4.30 p.m.

Fifth Sir M. Visvesvaraya Lecture

The Fifth Sir M. Visvesvaraya Lecture was delivered by Dr. M. S. Thacker (*M.*) at Rabindra Smaranee on Sunday, February 4, 1962, at 11.00 a.m. Maj.-Gen. Harkirat Singh, who was in the Chair, introduced Dr. Thacker to the gathering.

Dr. Thacker then delivered the Fifth Sir M. Visvesvaraya Lecture.* The subject of the Lecture was 'The Engineer and Society'.

Lecture on 'Technical Education in the U.S.S.R.'

A lecture on 'Technical Education in the U.S.S.R.' was delivered by Dr. V. M. Dokras (*M.*) at Rabindra Smaranee on Sunday, February 4, 1962, at 12.15 p.m. Maj.-Gen. Harkirat Singh, who was in the Chair, introduced Dr. Dokras to the gathering.

Dr. Dokras then delivered his lecture.†

Social and other events

Annual Dinner

The Forty-second Annual Dinner of the Institution was held on Sunday, February 4, 1962, at the Firpo's Hotel, Calcutta. Shri A. K. Sen, Union Minister of Law, was the Chief Guest. Many guests and over 500 members attended the Dinner.

After dinner, the President, Maj.-Gen. Harkirat Singh, requested the guests and members to rise and drink a toast to the President and the Republic of India.

The President, Maj.-Gen. Harkirat Singh, also proposed a toast to the Chief Guest. Shri A. K. Sen replied to the toast.

Shri S. Bandopadhyaya, Chairman, Bengal Centre, proposed a toast to 'Our Guests'. Shri A. B. Ganguly, Managing Director, Durgapur Industries Ltd., replied to the toast on behalf of the guests.

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* The Lecture will be printed in a subsequent issue of the *Bulletin*.

† The Lecture will be printed in a subsequent issue of the *Bulletin*.

Finally, a toast to 'The Institution' was proposed by Shri R. N. Majumder, Mayor of Calcutta. Dr. M. S, Thacker, Past-President, replied on behalf of the Institution.

'At Home' by the Mayor of Calcutta

The Mayor of Calcutta was 'At Home' to the delegates in the grounds of the Central Municipal Building on the evening of February 3, 1962.

Variety Entertainment of Folk Songs of Bengal

A variety entertainment for the delegates of Folk Songs of Bengal by Nirmalendu Choudhury and his troupe and Kathak dance by Ruby Dutta was arranged later the same evening by the courtesy of Electrical Manufacturing Co. Ltd., Calcutta.

Lunch by National Rubber Manufacturers Ltd. and Sen-Raleigh Industries of India Ltd.

A buffet lunch was given to the delegates by National Rubber Manufacturers Ltd. and Sen-Raleigh Industries of India Ltd., Calcutta, in the grounds of Rabindra Smaranee on February 4, 1962.

Film Show

Films on 'Khajuraho', 'Radha Krishna' and 'Dharti ki Jhankar' were shown to the delegates the same afternoon at 2.30 p.m. at the Calcutta Information Centre.

Lunch by D. N. Bhattacherjee

A buffet lunch was given to the delegates by D. N. Bhattacherjee, Calcutta industrialist, in the grounds of Rabindra Smaranee on February 5, 1962.

Dance Drama

A Dance Drama, 'Omar Khayyam', was staged later the same evening by Anadi Prosad and his Indian Progressive Ballet Group at Rabindra Smaranee for the entertainment of the delegates.

Lunch by Shalimar Tar Products (1935) *Ltd., Calcutta*

A buffet lunch was given to the delegates by Shalimar Tar Products (1935) Ltd., Calcutta, in the grounds of Rabindra Smaranee on February 6, 1962.

Popular Lecture by Dr. N. R. Sen

A popular lecture on 'Space Travel' was given by Dr. N. R. Sen, Retired Professor of Applied Mathematics, Calcutta University, at Rabindra Smaranee later the same evening.

Lunch by Braithwaite & Co. (India), Ltd. and H. N. Electricals

Another buffet lunch was given to the delegates by Braithwaite & Co. (India) Ltd. and H. N. Electricals, Calcutta, in the grounds of Rabindra Smaranee on February 7, 1962.

Variety Entertainment of Rabindra Sangeet

A variety entertainment programme was arranged later the same evening (February 7, 1962). A number of well known artists of Bengal sang Rabindra Sangeet, and Timir Baran and his orchestra also gave a performance.

Local visits

The delegates were taken on many local visits and tours of inspection. Amongst the places visited were:

Tour no. 1—Fan Factory of Jay Engineering Works Ltd., Bansdhoni; Central Glass and Ceramic Research Institute, Jadavpur; National Instrument Factory, Jadavpur; Institute of Printing Technology, Jadavpur; and Ramakrishna Mission, Narendrapur.

Tour no. 2—Works of Guest, Keen, Williams, Ltd., Andul Road, Howrah; Bengal Engineering College, Sibpur; D.V.C. grid substation, Andul Road, Howrah; and Botanical Gardens, Sibpur.

Tour no. 3—Works of The Dunlop Rubber Co. (India) Ltd., Sahaganj; works of Tribeni Tissues Ltd., Tribeni; Kesoram Rayon, Tribeni; and Bandel Church, Bandel.

Tour no. 4—Bata Shoe Co. (P) Ltd., Batanagar; Birlapur Industries; and West Bengal Government Exhibition, Taratolla Road.

Tour no. 5—Works of Jessop & Co., Jessore Road; control tower at Dum Dum Aerodrome; Petrol Engine Factory of Shri K. K. Roy, Dum Dum; works of Electrical Machines Corporation (P) Ltd., Jessore Road; and Pareshnath Jain Temple, Jessore Road.

Tour no. 6—Works of National Insulated Cable Co. of India, Ltd., Shamnagar; River Research Institute and Milk Centre, Haringhata; Kalyani Township; and Titaghur Paper Mills, Titaghur.

Tour no. 7—Works of Electric Lamp Manufacturers (India) Ltd., Taratolla Road; works of The Metal Box Co. of India Ltd., Hide Road; works of J. Stone and Co. (India) (P) Ltd., Taratolla Road; and works of Shalimar Tar Products (1935) Ltd., Hide Road.

Tour no. 8—Hindustan Motors Ltd., Uttarpara; works of The Alkali and Chemical Corporation of (I) Ltd., Rishra; works of India Aluminium Co. Ltd., Belur; J. K. Steels, Rishra; and Belur Temple.

Lunches and teas were given to the delegates during the visits by the various firms and authorities.

Study tours

Four study tours were arranged at the conclusion of the Session. These were:

Tour no. 1—Chittaranjan Locomotive Works; Hindustan Cables, Rupnarainpur; Maithon Dam and underground power station; Kumardhubi Fire and Silica Works, Kumardhubi; and Eagle Rolling Mills, Ltd., Kumardhubi.

Tour no. 2—Panchet Hill Dam and power station; Indian Iron & Steel Co. Ltd., Burnpur; Sen-Raleigh Industries of India Ltd., Pagladanga; and Bengal Paper Mill Co. Ltd., Raniganj.

Tour no. 3—Durgapur Steel Works; D.V.C. Barrage and thermal station; Durgapur coke oven project; A.V.B. project; Central Mechanical Engineering Research Institute; and coal mining machinery project of Heavy Engineering Corporation.

Tour no. 4—Viswabharati University; Massanjore Dam and power station; and Tilpara Barrage.

The delegates left Calcutta on the evening of February 9, 1962. They returned to Calcutta on February 12, 1962, and dispersed to their respective home stations.

Major-General Harkirat Singh

President 1961-62

PRESIDENTIAL ADDRESS

1. On behalf of the Institution of Engineers, I am very obliged to Dr. B. C. Roy for accepting our request to inaugurate this Convention. We know that most of the Ministers at present are very busy with the forthcoming General Elections but the presence of our Chief Minister amongst us is a clear indication of the fact that he attaches due importance to meetings of engineers and the work that they do. For that, Sir, we are thankful to you.

2. I am very grateful to the Council of the Institution of Engineers for having re-elected me as their President for another year. It is indeed a great honour and I pray that God will give me the strength to discharge this heavy responsibility.

3. As you all know, the Institution of Engineers was founded in 1921 with a membership of 138. The formal inauguration of the Institution took place in Calcutta on 23rd February, 1921. The Institution was granted a Royal Charter in 1935 and it was the first Royal Charter given to a body which had its origin and functions in India. The objects and purposes for which the Institution was constituted included the promotion and advancement of the science, practice and business of engineering in all its branches. The activities of the Institution continued to expand rapidly over the country. We now have 18 Local Centres and a total membership of nearly 32,000. The outstanding feature of this Institution is that, true to its Charter, it represents all branches of engineering — civil, electrical, mechanical, telecommunication, chemical, mining and metallurgy. In 1960, the General Body approved an amendment to our Bye-laws recommending the formation of functional Divisions within the Institution representing various main disciplines of engineering and giving them all equal share in the administration of the Institution. We recognize that the profession of engineers as a whole benefits from the closest possible cooperation between the various branches of engineering. In the planning, execution and operation of any large engineer undertaking, engineers of all branches have to work together as one team. During the last few years, however, there has been a tendency to form new specialists' societies for sub-branches of the engineering profession. In view of the successive Five Year Plans, it has been estimated that in about ten years time from now, the number of engineers in different branches will be 50,000 civil engineers, 47,000 mechanical engineers, 35,000 electrical engineers, 7,000 telecommunication engineers, 12,000 chemical engineers, and 8,000 mining and metallurgical engineers. In the best interests of the community and the advancement of the science and practice of engineering, it will be of immense value if all these engineers belong to one professional society.

4. To the engineers of India, the most topical subject of the day is the launching of the Third Five Year Plan which is to be the first stage of an intensive development programme leading to a self-reliant and self-generating economy. A study of the Plan indicates that almost three-quarters of the work required to be done under the Plan falls on the engineering profession. Straightforward engineering tasks like major and medium irrigation, power, transportation and communication, and industries comprise 62% of the Plan. In other fields like agriculture and community development and social services, there is a large amount of engineer work. Take, for example, agricultural

production. This requires land reclamation, soil conservation, irrigation works both by canals and tubewells, production of modern agricultural plant and tools, and production of fertilizers. These are all tasks to be performed by engineers. It has been roughly estimated that building construction alone under the Third Plan amounts to nearly 20% of the Plan, *i.e.*, nearly Rs. 2,000 crores.

5. It is one of the principal aims of the Third Plan to expand basic industries like steel, chemicals, fuel and power, and establish the machine building capacity, so that the requirements of further industrialization can be met within a period of ten years or so mainly from the country's own resources. Development of these basic industries itself rests mainly on the basis of power, transportation and technical manpower. The success of any Plan aiming at economic expansion depends on these three vital items.

6. The programme for power development in the Third Plan is of the order of Rs. 1,089 crores. This is for a target of 12.7 million kW at the end of the Third Plan as against 5.7 million kW at the end of the Second Plan. This will give us a rate of power consumption of 95 kWh per head of population as against a mere 14 kWh in 1950. Although this rate of progress seems to be impressive, requirement of electric power rises so rapidly with expansion that it is anticipated that power shortage will continue for a long time to come unless the Plan is expanded in this particular respect. Incidentally, the development of power in Japan from 1947 to 1958 had resulted in an increase of power consumption per head of population from 455 to 930 kWh. Similarly, during the same period in Italy, the power consumption per head had risen from 454 to 922 kWh. I quote these figures to indicate that we have a big leeway to make up in this respect to meet our ever-increasing requirements for industrial expansion.

7. Shortage of transportation has in the past caused serious bottlenecks in the progress of other activities in the Plan. Whereas railway development programmes go ahead as fast as practically possible, there is a strong feeling that road development programmes are very inadequate. The road programmes provide for the addition of about 25,000 miles of surfaced roads and also for improvement of the existing road systems, such as providing bridges and missing links and upgrading the existing roads. At the end of the Plan we will have 169,000 miles of surfaced roads. The quality of these roads is, however, so low that unless we spend huge sums on upgrading and widening and realignment *i.e.*, almost rebuilding of a large number of roads now, we will not be able to carry the traffic that may be anticipated by 1965-66.

8. Requirements of technical manpower have been worked out. In engineering and technology, provision has been made in the Third Plan for expansion of facilities at the degree and diploma levels so as to increase the annual admissions from 13,860 for degree courses and from 25,570 for diploma courses to 19,140 and 37,390 respectively. In addition there is provision for the different types of part-time and correspondence courses and for the establishment of some specialized institutes. Expansion schemes for craftsmen training have also been planned.

9. It has been stated by some that, in a technological society like the one we are aiming at, it is not only the producer that has to be scientifically trained but also the

consumer to enable him to make the best use of the advantages that modern technology offers. Moreover, if technical education was wide-based, it would have the dual advantage of throwing up suitable men for higher technical education and of creating a better understanding and appreciation of the technical revolution that we are going through. The Union Minister for Scientific Research and Cultural Affairs has often stated that it is his aim to have a polytechnic in every district in India. Recently, the Chief Minister of a progressive State told me that in addition to a polytechnic and craftsmen school in every large and small town he wanted craftsmen schools in large sized villages as well which in itself would tend to revolutionize village economy.

10. I am sure that we are all in agreement with these sentiments. There is no doubt that the expansion of technical manpower is the most basic requirement for economic development. In the last resort, a country's greatest riches lie in the quality of her manpower.

11. I have had various discussions with the heads of engineering colleges and other senior engineers in the country on this subject. Whereas increase in engineering colleges and schools is essential, some express doubt as to the quality of the new engineering graduates or diploma holders. We find that, apart from a few institutions which have already got all-India reputation, the new colleges are not all keeping up to the required standard. This is a most dangerous state of affairs. Any doctor would appreciate the danger to human life if we were to turn out men with M.B.B.S. stamps who were not fully trained. Although badly trained engineers may not cause damage to human life, they would definitely jeopardize our chances of industrial expansion and future prosperity. This question needs very serious consideration. The Institution of Engineers as a national body of engineers has the responsibility for recognizing various technical qualifications for exemption from Sections A and B of the Institution examinations. It is thus a body whose duty it is to set standards of technical education. We offer our services to the Central Board of Technical Education and the University Grants Commission to sort out this matter at the earliest.

12. A review of the progress made under the first two Plans during the past decade shows that although notable progress has been achieved in many fields, there have been some serious shortfalls in the industrial targets which the country set itself. These shortfalls have occurred in the industries which are of crucial importance. Such shortfalls have a chain reaction in the negative sense, as they create a lack of balance in the development of resources and thus hinder general growth. I feel that although there may not be any cause for us to be unduly diffident, at the same time, we should not be complacent about our past achievements. Not only are the achievements below our own anticipation, but compared with other countries, our rate of progress has not been very great. The advances made in technology and engineering during the last fifteen years have been so great that various countries which were badly devastated as a result of the last war are now far more prosperous than they had ever been in their long history.

13. We are not really a backward country. We have rich resources and we have many skilled men. Except for the U.S.A. and the U.S.S.R., we have more educated people than any other country in the world. Although so far we were able to do reasonably

well in spite of our outmoded methods, both administrative and technical, with the launching of the Third Plan aiming at the creation of a self-generating economy, a point has now been reached when we should carry out a detailed examination of our own shortcomings and create new organizational and technical patterns to achieve success. One may ask that when our past experience shows such gaps in expectation and achievement why do we embark on such a big Plan? The size of the Plan must be judged in comparison with our requirements, our resources and our technical skill, and the Plan should aim at a goal which would impel us towards the maximization of our national effort. Judged in this context, the Third Five Year Plan cannot be criticised for its boldness.

14. In the first place, it is very clear to me that the success or the failure of the Plan depends primarily on the community of engineers. I do not mean, Mr. Chief Minister, that your part in the success of the Plan will not be considerable but I do venture to suggest, Sir, that one of the major contributions that you and your colleagues can make to the Plan is in the backing that you give to your engineers who have to carry 75% of the load. As I feel confident of that backing, I want to put to my fellow engineers that if we fail it will be our fault.

15. What can the engineers do to ensure success of the Plan? The answer is that we must carry out all engineer tasks with the maximum economy and speed consistent with quality. This requires good planning, use of modern techniques, a sense of urgency, a sense of responsibility, of quality and integrity. Let me expand on them.

16. Every good engineer knows that no technical work should commence unless it is planned beforehand right down to its last detail of design, method of execution, its economics and its requirements in terms of men, material and machines, and its time factor. We know that time spent on thorough reconnaissance and investigation is never wasted. It should result in economy, saving in time required for completion of the work and higher quality of production. Yet how often do we see work commenced without full detailed plans? Sometimes, it is due to the fact that some V.I.P. wants to lay a foundation stone—at other times it may well be that some administrator or engineer wants to show off to gain a temporary advantage. But hurriedly starting a project or laying its foundation stone does not in itself help matters, because, after all, it is the time of completion of a project that matters.

17. Many of our construction methods and manufacturing techniques are quite outmoded. It is generally accepted that in the building industry, mechanization of construction techniques, standardization of components, and prefabrication would lead to large scale economies. Yet we are slow in adopting these methods. The difficulty is that standardization and prefabrication become paying only if most of the builders adopt tham, and no formula has yet been found to make various building agencies follow a common method. In spite of the efforts of the Central Building Research Institute, the National Building Organization, and the Indian Standards Institution, it appears that conservatism in building techniques and practice is hard to eradicate. Every engineer employed in building work should, therefore, make a conscious effort to keep up-to-date in new techniques. I would very much like to see a Research and Development Sec-

tion under every senior engineer executive, *i.e.*, head of a technical department in Government or in a large industrial concern. That will ensure that some technical staff will keep on constantly studying and experimenting with new designs and techniques which will enable the department or the industry to take advantage of all the latest technological advances. Similarly, every technical or industrial organization should have a 'productivity cell' or a 'work study group'—the Planning Commission calls it a 'cost reduction unit.' There is no doubt that during the last decade work study has made great progress and introduced such economies that no modern technical organization can really afford to ignore its efficacy. There is also scope to exercise certain economies in the field of materials management. It is estimated that nearly 60% of the cost of any construction or manufacture goes into the purchase of materials required for it. Engineers would do well to pay greater attention to this aspect.

18. With the amount of work that has to be done in the next five years, it is imperative that engineers develop a sense of urgency. No one who watches the leisurely work going on for the construction of a road almost anywhere in India would think that we were engaged in a serious effort to build up our country or were fighting a war against poverty. Take the widening of any road—either a national highway or a municipal road. It seems the widening of a road gets sanction only when the incidence of traffic has increased to such an extent that the existing narrow road becomes hazardous. During the first year of the work, road metal is collected on the berms which further reduces road capacity. Next year, one-half of the road width is cut up for reconstruction plus widening, so that we are left with only half a roadway for our traffic. After that, the process is repeated on the other half. A little later, the first half which had been carrying very heavy traffic during the reconstruction of the second half requires repairs. So, for quite a considerable time, instead of getting a wider road, we get a narrower road. This picture can be seen in many parts of India.

19. With the use of modern construction plant, road work can certainly be carried out in a fraction of the time that it takes now. And to take the maximum advantage of the capital expenditure on construction plant, I see no reason why work should not go on for 16 to 24 hours in a day as it does in war. Working double shift will increase our tempo of work, our employment potential, and will create a sense of urgency and an awareness of the importance of the task we are engaged in.

20. In many fields of development, construction costs account for a substantial proportion of expenditure. In the public sector, most of this construction gets done under the control of Public Works Departments through the agency of contractors. Costs of construction have been rising due to rising costs of material, transport and labour. Although some reduction in cost can certainly be made by using improved designs, standardization, prefabrication, etc., it can be stated without any hesitation that considerable economy can also be introduced by changing our rules, regulations and procedures. Take the Government contract form itself. We all know that it is one-sided; almost all the burden is placed on the contractor who is to cover himself not only against the normal business hazards but also against the bottlenecks and harassment imposed on him by the Government departments in the way of delayed decisions, delayed supply of controlled materials, delayed payments, and likely deductions from

final bills due to technical examination of bills years after the bills have been paid. It is considered that about 10% saving can be effected if contracts are made more equitable and final payments are made promptly. This means a saving of nearly Rs. 200 crores in the Third Plan. I urge upon my brother engineers to pay more attention to these aspects and ensure that everything possible is done to avoid extra expenditure due to procedural difficulties. If the present rules and regulations are in the way, we must compel our Governments to change them.

21. Another point to which I wish to draw attention is the quality of our work. If our work is costly or slow, we can still have the satisfaction of having done something, but if at the end of it all the quality of our output in construction of manufacture is poor, we can only hang our heads in shame. Quality is the hallmark of all good technical work. We owe it to our profession not to accept anything which does not come up to the required standard. Let us, as engineers, endeavour to make the words 'Made in India' synonymous with guaranteed high quality. Every technical organization must have its own 'quality control' set-up and the men in this set-up should be imbued with the missionary spirit not to accept anything which is below par. I am sure your workers will appreciate such a control. The potential technical skill of our craftsmen and tradesmen is as high as anywhere else in the world. It is only a matter of technical direction and quality control to utilize this skill to the best advantage. One may say that with our progressive Five Year Plans we will meet the quantitative requirements of our country for its journey towards prosperity. But I sometimes fear that, if at this stage, we sacrifice the requirement of quality, it will be extremely difficult to catch up later. The temptation to sacrifice quality is there for an industrialist or a contractor to make quick profits or for Government concerns to gain popularity. We must guard against this.

22. I said earlier on, that the success of the Third Five Year Plan which will lay the foundations for the prosperity of this country depends on the engineers. Qualitatively, it depends on the integrity of the engineers. I refer here to the higher professional integrity, that is, to keep ourselves up-to-date with the latest technological advances in the particular discipline that we are employed in, to give our technical advice without fear or favour, to realize our duty towards society and not to degrade ourselves for financial advantage or by sycophancy to curry favour with our superiors. We must also realize that all engineering is teamwork in which a number of engineers from different disciplines of engineering and different organizations have to work together. In this context mutual recrimination, passing the blame for any failure from one to the other, or letting down the junior engineers is certainly unprofessional conduct. I do not mean that if there is a technical failure there should not be a thorough investigation into it. On the other hand, such an investigation is essential as we learn a great deal from failures; a good deal of scientific progress comes out of investigation of failures. But I do mean that any such inquiry should be with a view to find the truth and not merely for apportioning blame.

23. The Institution of Engineers, as a representative body of the engineers in the country, has an important role to play in this respect. As part of its Charter for the promotion of engineering science, practice and business, it is to strive continuously to

create consciousness amongst its members of their duty to society, to their profession, and to one another. We are taking action to bring out a new Code of Ethics for members of the Institution and we shall take necessary steps to enforce this Code.

24. There are certain aspects of engineering tasks in the Third Plan which require Governmental reform. I say Governmental reform because it is in the very nature of the Plans and the pattern of society we are creating that all progressive reforms have to emanate from Governmental sources. The Government engineer both in a Government department and public industrial concern has heavy responsibilities, but by and large, he has not been given commensurate authority, liberty of action, and trust to enable him to fulfil those responsibilities. Too many controls have been introduced in the name of accountability resulting in delays, inefficiency and frustration. There is a general mistrust of the engineers and when small things go wrong an inquiry tends to become an inquisition. The Planning Commission has dealt with this problem in their Third Plan and has made some recommendations. We do hope that the Central and State Governments will take notice of these. The Planning Commission has also created a panel under the Committee on Plan Projects for examining public works administration. The report of this panel is expected to come out shortly and we hope it will be acted upon.

25. It was as a result of the growing consciousness of the role of engineers in building up the prosperity of this country that the Institution of Engineers organized a Symposium last November on the 'Economy and Efficiency of Engineering Enterprises in India.' The Symposium was attended by a large number of senior engineers from the technical departments of the Centre and the States, and public and private undertakings, universities, scientific and technical organizations, and research establishments. All branches of engineering were represented. The attendance was so much that it set a record for technical symposia in Delhi. As far as I know, never before in the history of India had so many top engineers of the country got together. The most important thing was that they were all unanimous in their general diagnosis of what was wrong with the administration of engineering enterprises which result in lower output and higher costs. It became very clear in the Symposium that there is an urgent requirement to reorganize Government technical departments and to reorientate our concept of management of industrial enterprises. The members felt that if this was not done the success of the Third Five Year Plan would be jeopardized. The Union Home Minister who inaugurated the Symposium declared that he would soon appoint a high level committee to go into the points that were brought out.

26. I will now present briefly the main issues that were brought out by this highly representative body of engineers at the Symposium. Under the term 'engineering enterprises' were included all large industrial undertakings of a technical nature like production of power, steel, industrial machinery, machine tools, fertilizers, etc. and also technical departments of the Government for the construction and maintenance of irrigation works, roads and buildings, and other similar organizations. It was found that management of the great engineering enterprises in the public sector had been vested with the administrative services. The engineer who has to carry the major burden to produce the results is often harassed by the administrator, auditor and

accountant. This point needs no labouring and it is not only the engineer who knows it but all sections of the community are aware of this malaise, a handing down from a tradition which has long outlived itself. It was clearly demonstrated by a large number of examples that although the present bureaucratic pattern of administration may have been suitable for the maintenance of law and order it was not competent to deal with the requirement of a nation aiming at rapid economic development. It was considered that if the administrative pattern was not modified soon the technical men would find themselves incapable of coping with the vastly increased tempo of work that the Third and subsequent Five Year Plans would impose on them. At this stage of development of our country, I submit that a point has been reached when administration must be reorientated to concepts of action as opposed to concepts of caution. I feel that the most important task that we have in front of us is to increase the productivity of every man, every machine, every ounce of fuel, and every acre of land, so that in the implementation of our great plans we get one hundred naye paise worth out of every rupee.

27. Many Government engineers at the Symposium pointed out that they had to spend a good deal of their time in dealing with a host of secretariat officials, financial advisers and auditors and as a result of it, senior engineers, whose task it was to direct and guide the activities of their large technical departments, were themselves reduced to file pushers. If the head of a technical department wants any improvements or introduction of modern techniques in his department, it is not enough for him to just prepare a proper scheme. He has to have endless patience and cunning to steer his scheme through a large number of channels, called 'proper channels.' And he himself has very little authority to do anything except routine work. How then do we expect big tasks to be carried out, initiative to be used, and technical progress to accrue? Let me quote the Planning Commission:

> 'Lack of delegation within the enterprise is another common failure. Even as the general manager does not enjoy sufficient authority to manage effectively, there is often a failure by him and other management staff in the hierarchy to delegate authority to others down the line, who cannot do their jobs properly without the necessary authority. The lack of delegation of authority is usually accompanied by a failure to define responsibilities and duties. Nobody can operate confidently or effectively or be held responsible for results unless he knows what he is supposed to do and has the authority to do it.'

That was stated by the Planning Commission.

28. Let us face the fact that after all the basic procedural pattern of Government administration has not changed much since the days 'Sardar Patel discovered that though he was Home Member he could not create so much as the post of a *chaprasi* without Liaqat Ali's concurrence.' † This pattern is based on a network of rules and regulations developed some thirty years ago which were designed to ensure bondage for those who dared be progressive. Strong opinions were expressed by many of those who attended the Symposium that urgent action was necessary to revise all the old rules and regulations, redefine relative responsibilities of various types of officials in the Government, and delegate authority to those who have the responsibility for results.

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† Maulana Abul Kalam Azad in 'India Wins Freedom', p. 193.

Let me repeat it. *Urgent action is necessary to revise all the old rules and regulations, redefine relative responsibilities of various types of officials in the Government, and delegate authority to those who have the responsibility for results.* As President of the Institution of Engineers, on behalf of the engineering profession in India, I am duty bound to urge the Governments to consider these suggestions.

29. In the end, Ladies and Gentlemen, let me say, that we are all convinced of the importance of the Third Plan. We congratulate the Planning Commission for this excellent task. As engineers, we are happy at the opportunity it will give us to serve our Motherland. We are conscious of our great responsibility, and with God's will, we shall discharge it well. We know that our country is now on the threshold of great developments for which in time to come the sky will be the limit. We are at a stage when we can justifiably think, as Iqbal has said in 'Javab-i-Shikva', that

کوئی قابل ہو تو ہم شانِ کئی دیتے ہیں
* ڈھونڈنے والوں کو دنیا بھی نئی دیتے ہیں .

30. I now request Dr. B. C. Roy to kindly inaugurate this 42nd Annual Convention of our Institution.'

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* *I give many glories to those who are able;*
I give even new worlds to those who search for them.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Bombay Centre

Chairman's address by Shri N. K. Gandhi, B.E., M.I.E., at the 40th Annual General Meeting of the Centre on December 20, 1961

The Chairman welcomed the Chief Guest, Shri Y. B. Chavan, Chief Minister of Bombay, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

During his address, Shri Gandhi spoke on major aspects of planning and Local Government administration. He said, 'Town planning is both an art and a science. As an art, it can be traced to ancient civilizations; as a science, it has advanced only recently, but with rapid strides. The objectives of town planning as a science have been continuously changing from mere physical planning to the modern concept of planning for the people.

In mediæval times, the objective in town planning was defence, so that towns were surrounded by fortification for protection against invaders.

In the Renaissance period, the emphasis was shifted to monumental planning; long, straight and wide roads with avenues of trees and architecturally beautiful buildings were the main features. Towards the end of the last century came the industrial era. A large number of factories were established to the detriment of living conditions of the population, who were looked upon only as 'hands' working in factories.

The sordid, dreary and congested living conditions of the people in the industrial era gave rise to epidemics and misery. This was the beginning of the modern concept of designing towns for the social wellbeing of the people. Sir Patrick Geddes, a modern town planner, initiated the theory of organic town planning for 'folk work and place.' According to him, a town should be designed for living, work and play. He was also the pioneer of the concept of 'survey before plan' for each town. A plan should not be imposed upon a town but should be evolved after carrying out detailed physical and socio-economic surveys. The underlying principle of these surveys is to observe, understand and foresee.

Since then, there has been rapid advancements in the concept of town planning and the technique of planning surveys. 'Land use' plans are used to show in different standard colours how an existing building or land is being used, its potentiality for development is valued, and its future use is assigned. Starting from the concept of developing small areas, the necessity for developing the town as a whole was recognized. Then came regional planning, and now planning in its physical sense means fixing the use of land in the interest of the people.

Absence of trained planners and maps

We have adopted, in some measure, the modern concepts of town planning mentioned above, but not the spirit. The Government of Bombay adopted a comprehensive town planning law in 1954 (1957) whereby it was made obligatory upon every local authority to carry out surveys and prepare a development plan for the areas under their jurisdiction. The development plans were to be submitted within four years, *i.e.*, before 1961. However, most of the local authorities could not even make a beginning with the survey work. Two major difficulties were experienced in this work, (i) dearth of technical personnel, and (ii) non-availability of maps.

The training facilities for planners in the country are meagre, but no serious attempt is being made to provide the same for the large number of such personnel required. We seem to believe that any engineer or architect will be able to do the planning work for which no special training is necessary. In Bombay, a certificate course in town planning has been started where less than 12 students are trained every year. There are diploma courses at Delhi and Kharagpur but the total number of students in these institutions is not more than 50 per year. In England, training facilities exist for a large number of students, yet it is difficult to procure adequate staff for planning work.

Even with the availability of technical staff, real planning work cannot be done unless maps to the required scale are available. We have, at present, only topo sheets to the scale of 1 in. to a mile and above. These show only hills, valleys, orchards, etc. The revenue survey sheets to the scale of 1 in. to 330 ft. show only the different holdings. For town planning surveys, larger size maps are necessary, at least to the scale of 1 in. to 80 ft. or 100 ft., wherein all buildings, widths of roads, etc. are shown.

At present, the mapping work is done by the Revenue Department, but the Department will not be able to cope with this work, which is spread all over the State, within a short time due to the limited staff available for such work. We must, therefore, train adequate number of surveyors to do the work expeditiously. Planning survey maps do not show individual holdings but only the existing developments, *i.e.*, whether built or unbuilt, the use, *i.e.*, agricultural or barren land; and in case of buildings, whether these are residential, shops, industrial, etc., with their condition. Qualified persons such as engineers and architects are not required for this kind of work. Even matriculates can be entrusted to do this work after preliminary training for about six months.

Maps are the basic raw material for the preparation of development plans, and these should be prepared by trained surveyors. The land use maps and the 'condition of buildings' maps, prepared after field inspection, provide correct data for the existing conditions. At present, these data have to be collected from records and statistics usually compiled after casual inspection only. Analysis of the survey data available from maps can be made and proper use for the land fixed after evaluating its suitability. This planning work should be entrusted only to trained and experienced planners as the considerations involved include socio-economic and population studies and traffic circulation requirements in addition to engineering and architectural knowledge.

Distribution of industries

Two vital components of planning are industry and housing. The policy of the Government to establish industrial estates in rural areas is welcome, but the objective must be to improve the condition of the rural population by providing more employment facilities. However, along with each industrial estate, a separate housing colony is established on the outskirts of the village or town. The new colony is provided with all modern amenities such as good houses, piped water supply, sewerage and drainage, while the old settlement continues in its derelict state. Moreover, good agricultural land is taken away for the construction of factories and residences.

It must be remembered that agriculture is also an industry—a vital industry. Payment of monetary compensation for the loss of land and home is hardly fair. Such action is justifiable only in river valley projects where the land will be under water after the completion of the project. In industrial and other development projects, the proper course is to select only non-agricultural barren land for factories while integrating and absorbing the existing villages in a new and expanded township so as to ensure organic planning. In the U.S.S.R., when it is decided to install a large industry in an area, preference is given to local inhabitants by training them in the trade before starting the industry.

The type of industrial development taking place along the Bombay-Poona Road between Kirkee and Lonavla is not very commendable. Along this road, there are industries on one side and houses on the other, close to one another. Time is not far when for long distances open land or greenery will not be visible. This development is similar to the sprawl along the Grand Trunk Road between Calcutta and Asansol, a distance of more than 100 miles. The Durgapur steel plant, the Heavy Engineering Corporation, the AVB project, and other public and private industries form part of this development, with industries on one side of a busy National Highway and separate housing colonies for each industry on the other. Similar pattern of development is seen in all new private and public industries under the Five Year Plans. The big industrial developments at Murbad Road, Kalyan, Poisar (near Thana), Khopoli, and Lonavla are instances of this type of development. This shows that we are still in the era of 'planning for industries' and not 'for the people'. There is neither regional planning nor any organic basis for planning.

From proper physical and economic planning principles, development should be balanced and integrated. A town should not depend upon one industry only, but there should be a balance between heavy, medium and light industries. The population employed in such industries should be of a mixed type so that if one industry has its bad days, the whole town will not suffer.

Recently, a number of large sugar mills have been set up in the State. The employment available in these mills is only seasonal. If, along with these mills, other factories are also established for processing of auxiliary products such as bagasse into paper, hay into cardboard boxes and light partition materials, food preservatives, dairy products, etc., not only will the by-products of the main industry be utilized, but more employment facilities will be available. Fluctuations in sugar market will, therefore, not affect the population in the area to a large extent.

The Government is therefore urged not to allow establishment of only one industry at one place but to have mixed industries. For this purpose, Development Corporations will have to be established for each town, to whom all development and control work in the area will have to be entrusted.

Housing

The other vital part of planning is housing, and it requires considerable rethinking. A large number of new houses are necessary, apart from improvement of the large number of existing sub-standard houses. The problem, however, is not merely of numbers. The social impact of housing development has to be studied in proper perspective. This problem is being tackled under four main categories.

(i) Employee housing schemes, in which houses or tenements are provided by the employer.

(ii) Low cost housing schemes, comprising housing schemes for low income groups, slum clearance schemes, etc. This work is done in the public sector through housing boards and municipalities.

(iii) Investment housing schemes, comprising residential accommodation put up by private land owners with a view to getting adequate return on their investment.

(iv) Ownership housing schemes, in which houses are constructed by individuals for their own use, either on individual or cooperative basis.

I will now examine objectively the social and economic impact of housing developments resulting from each category.

(*i*) *Employee housing schemes*

Under employee housing schemes, every employer is called upon to provide accommodation for his employees for which every encouragement, including financial assistance, is offered. The benefits of such schemes for the employees are that housing is provided near the site of their work, thereby reducing the time and expense of travelling. Against this advantage, the following factors need consideration :

(a) The housing facility is closely tied with employment. On retirement or leaving the service, the employee loses it.

(b) The accommodation is provided strictly according to pay and status, resulting in social segregation and stratification which the employee and his family are always conscious of.

(c) The home life is subjected to disciplinary rules framed by the employer, which amount to interference in one's private life.

(d) There is lack of opportunity for mixing with others with the result that the employees are always thinking of promotions, transfers and shop talk in which the family also duly participate.

From the point of view of the employer, he has to undertake this development out of compulsion. A large portion of the finances has to be diverted to this non-industrial development. He has also to look after the maintenance and repairs, amenities and services, etc., thus diverting his attention from industrial production.

From the point of view of the public, this development is hardly favourable either in its economic or proper planning interests. The cost of a manufactured article increases because to the cost of production, the cost of providing accommodation to the employees and its maintenance is added. As housing and factory are provided in the same area, the development contravenes zoning rules in urban areas, while the land outside the area remains in the nature of a sprawl.

It must be recognized that housing and employment are two essential but separate requirements and it would be wrong from long term planning point of view to tie them together. However, exceptions such as for defence, police, and other essential services have to be made.

(*ii*) *Low cost housing schemes*

The present developments in urban areas under low cost housing schemes have to be properly viewed. In this connection, it would be pertinent to refer to the report of the International Federation of Housing and Town Planning, which recommends that

(a) the solution of the problem must not be sought by choosing as an objective the reduction in housing costs if such reduction would be detrimental to the quality of the housing, and

(b) in underdeveloped countries, solution of a temporary nature should be avoided as this becomes a pretext for poor quality of housing.

However, low cost housing is being considered the same as standard housing. In order to keep the cost low, either the number of rooms and their areas are reduced or the specifications are so toned down that sometimes essential amenities such as independent sanitary accommodation are denied.

(*iii*) *Investment housing schemes*

With the rising prices of land and building materials, rents are increasing every year. Only the people in higher income groups are in a position to pay the rents demanded by private investors. They will thus cater to a limited number. Besides, the interests of the owner and the tenant are conflicting. Reliance on private enterprise for solution of the housing problem is, therefore, justified.

(*iv*) *Ownership housing schemes*

Housing must be looked upon as a social service along with education, health and other services. This service has, therefore, to be financed by public funds and subsidized rents.

Use of public funds in low cost housing schemes results in a number of drawbacks, as pointed out earlier. A large portion of the funds can be more usefully utilized in encouraging ownership housing schemes. Ownership inculcates a sense of belonging, and therefore cost of maintenance and repairs through public funds is saved.

Only monetary help for housing schemes is not sufficient. Positive results will be achieved only when developed plots with roads, sewerage, water supply and electricity are made available, and adequate supply of building materials of good quality and standard at reasonable price is ensured.

The manufacture of adequate quantities of building materials is a matter of planned production, and greater production means more employment in the region. Bricks can be manufactured in large quantities in rural areas by utilizing riverside silt as the raw material and cowdung gas as fuel. With little mechanization, hollow bricks can also be manufactured. In suitable areas, lime kilns can be established with mortar mills. Doors and windows can be standardized and manufactured on a mass scale in the new industrial estates.

Methods to ensure organic planning

To ensure organic planning, planning and development in an area should be entrusted to a single authority—to local authorities in the case of urban areas and to Development Corporations in new towns. These bcdies should provide developed plots both for housing and industries, and should be responsible for all services and amenities.

Housing should be on neighbourhood principles, and not divided into groups serving particular industries and establishments.

Local Government administration

Now I shall refer to some general matters concerning Local Government administration. These relate to some procedural matters at present in vogue in the different municipalities whereby in some cases the provision of essential services and other amenities in the area are inordinately delayed, causing annoyance and frustration. Amenities delayed are amenities denied. These matters can be improved and efficiency increased if the following suggestions are adopted.

(i) *Public health and town planning schemes*

The present practice in the municipalities other than the corporations is that projects connected with public health, such as water supply and sewerage, are designed and executed by the State Public Health Department, and the schemes of town planning and development by the Consulting Surveyors Department. These departments handle a large number of schemes on behalf of the different municipalities, and it is common experience that the designs and estimates for water supply schemes and formulation of town planning schemes remain under consideration for a very long time. The reason is that these departments have a limited staff, many of them being fresh graduates. In the Consulting Surveyor's Department, there is hardly any qualified planner. They are conversant neither with the local conditions nor with local problems. The result is that citizens are denied the necessary services, though promised from time to time. Under the Third Plan, a number of water supply and sewerage schemes have to be undertaken in different urban areas. It is necessary that following the provisions of the B.T.P. Act, comprehensive development plans are prepared after carrying out planning surveys in the prescribed manner and in accordance with modern town planning concepts. The targets can be achieved only if this type of work is distributed amongst qualified and experienced practicing public health engineers and town planners, a large number of whom are available in the State, and whose services can be utilized for these purposes. This practice is followed in the Western countries also. In this way, not only the works will be expedited but they will be done to proper standards by qualified and experienced persons, resulting in overall economy and efficiency.

(ii) *N.A. permissions*

At present, there is dual control over private building developments in municipal areas. For the construction of a building in a municipal area, N.A. permission is required from the revenue authorities in addition to municipal permission under the building bye-laws. This causes unnecessary delay. Can it not be so enacted that all land falling within a municipal area is subject to only municipal control, so that no separate N.A. permission is necessary. The system adopted by the Bombay Municipal Corporation in suburban areas may be followed. The municipality sanctions the plans with a note that the owner should pay the required N.A. assessment charges, and a copy of the sanctioned plan is sent to the collector.

(iii) *Permission for subdivision of land*

There is greater anomaly in respect of subdivisions of large plots. Such subdivisions are sanctioned by the Consulting Surveyor's Office without referring them to the municipality. In some cases, subdivisions are sanctioned by the Sub-Registrar. This practice must cease. Under the B.T.P. Act, the local authority is the planning authority for the area and hence, in the interest of proper development, all power to sanction the subdivision must vest in the body.

There is another practical difficulty in enforcing the rule regarding subdivisions. Transfers of plots are done in a Sub-Registrar's office. Parties sell their land in small plots without obtaining the necessary sanction but the transfer deed is duly recorded in the Sub-Registrar's office. The Sub-Registrar cannot object to any such transfer, provided all legal formalities are duly complied with. To remedy this, it is suggested that there should be some legal provision in such transactions whereby a party must produce no objection from the municipality for land transfer.

The role of the Institution

The Institution represents all branches of engineering. Recently, the Bye-Laws have been amended to have seven major Divisions, Civil Engineering Division, Mechanical Engineering Division, Electrical Engineering Division, Chemical Engineering Division, Electronics and Telecommunication Engineering Division, Mining and Metallurgy Division, and General Engineering Division. With industrial and other developmental activities in full swing, it would be in the interest of economy and efficiency if suitable representation is given by the Government, public bodies and private industries to the Institution in all technical committees, project management, etc. A representative selected by the Institution will be more appropriate than any other individual in his own capacity. I hope and trust that the Government will place more confidence in the Institution and give it suitable recognition by associating its members in all technical committees and projects.'

Summaries of Papers Published in the Journal, vol. 42, no. 7, pts. CI4, ME4 & MM2 March 1962

CIVIL ENGINEERING DIVISION

Formation Constants of Water Bearing Strata

M. Y. Ansari
Associate Member

The equilibrium formula for radial artesian flow conditions does not take into account the time factor, and the supply of water from a well may be reduced to zero after it is in operation for some time. In practice, while pumping from a well penetrating an extensive aquifer, the influence of the discharge extends outward with time. With brief definitions of the 'formation constants' of water bearing strata, *viz.*, 'coefficient of transmissibility' and 'coefficient of storage', the paper reviews the several methods available for computing these constants. Some simple solutions are mentioned which are sufficiently accurate for field purposes.

An Investigation on the Liquid Limit of Some Indian Soils

R. Nagarajan
Non-member

As a result of investigation on the liquid limits of a few Indian soils, the relationship, $L = W\left(\frac{N}{25}\right)^{0.0951}$, was arrived at between the liquid limit, L, and the water content, W, at which the standard groove made on a wet soil closes at a specified number of blows, N. It is shown that the value of the index, *viz.*, 0.0951, does not vary significantly for the soils tested. This formula can be used to estimate the liquid limit from a single estimate of the water content of the soil and the number of shocks at which the standard groove closes during the liquid limit test. Hence, this method is known as the 'single point method of determination of the liquid limit'. The error involved in the estimation of liquid limit according to the usual procedure (British Standard 1377 : 1948) has been studied; and it is shown that the standard deviation in the results obtained according to the British Standard amounts to 1.84%, whereas that obtained by the single point method is about 3%. Considering the quickness with which results can be obtained, the single point method gives a reliable estimate of the liquid limit when compared with the conventional method.

An Experimental Study of Air Entrainment Characteristics of Hydraulic Jump

N. Rajaratnam

Non-member

This paper presents the results of a study on the air entrainment characteristics of hydraulic jump for Froude numbers from 2.42 to 8.72. The study included the development of an air concentration probe ideally suited for measurements in a hydraulic jump. An analysis of the variations in the mean air concentration, the ratio of air discharge to water discharge, and the air concentration distribution along the length of the jump is given. A new rational criterion is proposed for the length of the hydraulic jump, based on a certain percentage of the mean air concentration.

Foundation Exploration at Nagarjunasagar Dam

R. C. Rao

Associate Member

A thorough knowledge of the foundation characteristics is essential for the construction of a safe and economical structure. These are obtained from geological data based on careful examination of the site, including detailed investigations of the characteristics of the rock bed and its faulting and jointing. The object of the exploration is to ascertain (i) the nature of overburden and its depth; (ii) the depth at which hard, fresh and sound rock is met with and its composition and characteristics; and (iii) the impermeability of the foundation rock over which the dam is to rest. These data are collected by drilling holes into the foundations and securing samples or cores for identification and testing. The extent of exploration work and the degree of grouting are usually governed by the characteristics and conditions of the foundation and the type of structure to be built. Large and costly structures justify considerable expenditure on exploratory work, since economics in design and construction can be effected by the elimination of uncertain foundation factors. This paper gives a brief outline of the exploratory work done for the foundations of Nagarjunasagar Dam in Andhra Pradesh.

Plant Selection and Layout with Special Reference to Rihand Dam

A. N. Rau

Associate Member

While is not posible to layout any hard-and-fast rules to effect economy and efficiency in project construction, it is essential that planning must follow well-formulated principles of plant selection and layout, taking into consideration factors such as site conditions, methods of construction employed, availability of materials, men and general facilities, financial implications, possibility of transfer of equipment from one job to another, etc. The paper describes how mechanization and planned plant selection and layout have helped the progress of the Rihand Dam project in Uttar Pradesh.

Hydraulic Jump Stabilization

K. Seetharamiah
Member
and
A. S. Ramamurthy
Non-member

Stilling basins are designed below hydraulic structures to dissipate the hydraulic energy of the flow passing over a spillway or through a sluice. Hydraulic jump is an efficient device to dissipate the flow energy. The design conditions in a stilling basin generally provide a more or less constant tailwater depth, which permits the formation of a hydraulic jump for a particular discharge only. To ensure against the formation of a washout jump or a drowned jump due to variations in the discharges through the basin, certain appurtenances will have to be provided in the basin. This paper deals with the investigations conducted to determine the extent to which jump stabilization can be effected by the use of friction blocks. The data presented in dimensionless form serve as a guide to know the feasibility of using blocks as stabilizing accessories in the basin.

ROADS AND ROAD TRANSPORTATION GROUP

Dense Graded Asphaltic Paving Mixtures

K. S. Sankaran
Associate Member

In this paper, design considerations governing the satisfactory performance of an asphaltic paving mixtures are discussed, and the design concepts of a dense graded asphaltic concrete are indicated. The paper also reviews the widely adopted asphaltic paving mix design procedures. It is brought forth that in all the existing design procedures laboratory designs have been reasonably well correlated with field performance of paving mixtures, based on laboratory experiments. A suggestion is made to use the A.S.T.M. compression test as a test for stability measurements by virtue of the portability of the testing unit and the simplicity of testing. Design criteria for the determination of the asphaltic content of a paving mixture are recommended as a tentative design measure with a view to modify the criteria from time to time based on proper field correlations.

MECHANICAL ENGINEERING DIVISION

Measurement of End-Positional Errors due to Stick-Slip in Precision Machine Tools

S. C. Das
Associate Member
and
A. K. Basu
Non-member

During the last two decades, much work has been done on the phenomenon of stick-slip and to explore the mechanics behind it. It has also been established that this phenomenon of stick-slip has a deleterious effect on the functional aspect of high precision machine tools. In this paper, based on a series of tests by the authors, an attempt is made to determine the magnitudes of end-positional errors due to stick-slip in precision machine tools such as jig boring, cylindrical grinding, milling, etc. The set-up has been thought out with corrections for personal errors. It is hoped the tests results embodied in this paper will be of value to designers and users of precision machine tools.

Development of Modern Large AEG Steam Turbines

Dr. Ing. Max Ludewig
Non-member

The AEG have been building steam turbines for about 60 years. In the course of this time, the operating conditions and the design of steam turbines have undergone revolutionary changes and the AEG have had a decisive part in this development. Giving at first a brief survey of the history of steam turbine development followed by illustrations, the author deals with the problems encountered nowadays by the manufacturers of this highly developed prime mover.

Effect of Secondary Rake with Restricted Contact on Average and Maximum Chip-Tool Interface Temperatures

N. Ramaswamy
Non-member
and
A. Bhattacharyya
Associate Member

This paper presents the results of experimental and theoretical investigations undertaken by the authors to explore the role of secondary contact in the performance of controlled contact cutting tools in effecting the mechanics of cutting, the mechanism of chip formation, and the temperature distribution at the chip-tool interface. An analytical study is made of tool-chip interface temperature using the data obtained from the experiments on the mechanics of cutting. An attempt is made to verify the analytical results with the experimentally obtained values.

MINING AND METALLURGY DIVISION

Planning for Shaft Winding Equipments at Collieries and Shaft Ventilation

U. P. Mullick

Member

The Ruhr collieries are well known for extensive coal raising. This paper examines the pithead gear and shaft winding system used in the Ruhr district, in Britain, and in India. By means of proper design, it is possible to use both the cage and skip systems and steam and electric winding gears according to circumstances. The working at Ruhr collieries shows that shaft depth increases with large tonnage outputs, and up-to-date shaft winding arrangements with 4-deck cages and low speeds ensure high raisings—as much as 16,000-20,000 tons per day per shaft winding plant. Hence, attention has to be given to suitable guide arrangements, design of coal cars, winding gear, winding rope, head gear, etc.

Cage and skip winding systems need improvements in the light of the experience gained. Single-deck and multideck loadings and winding speeds will have to be considered. By reducing the speeds, the tonnage can be improved considerably. Multirope winding systems, location of winders, Ruhr type of pithead frames, air resistance and air pressure in shafts, and design of shaft equipment with reference to the diameter and the useful area to be covered by the equipment are important features which require attention. Besides, transport of coal from the shaft to the cleaning and screening plant, and of men, materials and rock, and problems of two-shaft collieries also require careful consideration.

Aspects of Colliery Management for Improved Efficiency

R. D. Singh

Associate Member

India produced 38 million tons of coal in 1955. The target for the Second Five Year Plan was 60 million tons, and the Third Five Year Plan has fixed the target at 97 million tons by 1965-66. It is gratifying to note that the rate of production in the Second Five Year Plan has been achieved, but it is to be maintained and the additional 37 million tons will have to be obtained in the Third Five Year Plan. This means that the country will have to add 7.4 million tons to its production of coal every year, a task not achieved by any other country except by the U.S.S.R. and Communist China. It needs no emphasis that this production must be obtained at a reasonable cost so that the consumer is not heavily taxed. The answer to the problem may be in putting in more machines, in opening new mines, in employing more men, and so on. Some are of view that it is necessary to have an additional increase of Rs. 3 per ton in coal price to achieve the Plan target. There may be so many other views and means, but it cannot be denied that there must be a good and strong management to manage the activities of every mine if success is to be attained. This management aspect is common to all mines, with little variations no doubt, and needs careful planning and foresight. In this paper, some salient aspects of management are discussed in as much as they affect efficiency, and solutions to the present problems are suggested, keeping in view the Indian conditions and labour.

INSTITUTION NEWS

Inauguration of the Roorkee Sub-Centre

The Roorkee Sub-Centre, which was opened on August 24, 1961, as announced in the *Bulletin* for December, 1961, was formally inaugurated on December 17, 1961, by Maj.-Gen. Harkirat Singh, President.

Shri G. Pande (*M.*), Chairman, Roorkee Sub-Centre, introduced the President to the gathering. The President while inaugurating the Sub-Centre welcomed its formation and wished it success.

Public Charitable Trust for the Advancement of Engineering Education—Prize for the best paper on 'Hydraulic Similitude'

Attention of members is drawn to the announcement by the Trustees of the Public Charitable Trust for the Advancement of Engineering Education of a prize of Rs. 250, donated by Dr. K. L. Rao, Past-President and Past-Chairman of the Trust, for the best paper on the subject of 'Hydraulic Similitude' submitted by an engineer and the publication of the prize winning paper and two other papers adjudged by the Trustees to be the next best in the Civil Engineering Division Part of the Journal (*vide Bulletin* dated May 1960). Since there has been no response to this notice so far, the period for submission of papers has been extended up to August 31, 1962. The papers should be sent to the Deputy Secretary at the Headquarters Office, marked Paper on 'Hydraulic Similitude', on or before the above date.

Committee on Floods

The Council at their 420th Meeting held in Calcutta on September 9, 1961, decided to appoint a Committee on Floods to study the problems of floods in India and to submit a report of their findings, with a view to enable the Institution to suggest the outlines of a national policy to be recommended to the Government of India for the prevention and control of floods.

Accordingly, as authorized by the Council, the President has constituted a Committee consisting of Shri Dildar Husain (*M.*) (*Convener*), Shri P. R. Ahuja (*M.*), Prof. N.

SHRI G. PANDE, CHAIRMAN, ROORKEE SUB-CENTRE, INTRODUCING THE PRESIDENT

MAJ.-GEN. HARKIRAT SINGH, PRESIDENT, INAUGURATING THE ROORKEE SUB-CENTRE

S. Govinda Rao (*M.*), Shri C. L. Handa (*M.*), Shri D. V. Joglekar (*M.*), Shri B. P. Kapadia (*M.*), Shri S. Varadaraja Sarma (*M.*), and Dr. H. L. Uppal (*M.*)

The Committee may have to visit the different parts of the country liable to periodic floods, in order to assess the problem in its various aspects. It is the desire of the Council that the Committee should go into action as soon as possible in order to provide a preliminary assessment of the problem, and that the recommendations of the Committee should be available by the end of June 1962.

Misdemeanour in Institution Examinations

The Council have decided to cancel the results of the following candidates for the November 1961 examinations and debar them from appearing in the two immediately following examinations, *i.e.*, up to and including November 1962, for misdemeanour in the aforesaid examinations.

Studentship No.	Roll No.	Name
S. 26719	5448A	Nimai Chandra Sinha
S. 30197	3806A	Prem Kumar Seth
S. 31000	4059A	M. Ramachandra Sastry
S. 32224	3966A	Ram Anugrah Lal

The Council have decided to cancel the results of the following candidates for the November 1961 examinations and debar them from appearing in the three immediately following examinations, *i.e.*, up to and including May 1963, for misdemeanour at the aforesaid examinations.

Studentship No.	Roll No.	Name
S. 27066	3783A	Bhagwan Prakash Sinha
S. 28855	3488A	Vijay Kumar Gangal

INSTITUTION NOTICES

New scheme of examinations in Sections A and B of the Associate Membership Examination

Further to the notice given on pages 36-41 of the *Bulletin* dated November 1961 regarding the introduction of the new scheme of examinations from November 1962, the Council of the Institution have now made certain modifications reading as under:

1. The new scheme of examinations will be introduced from November 1962, and the existing scheme and new scheme of examinations will run concurrently up to November 1964.

2. Candidates wishing to appear for the first time in Section A or Section B or those who have not secured any exemption previously under the existing scheme, will be given option to appear under the existing or new scheme of examinations up to November

1963. If such candidates fail to secure exemption in any subject of the existing scheme by November 1963, they will have to appear in the respective Sections under the new scheme from May 1964.

3. Candidates securing one or more exemptions in Section A or Section B under the existing scheme in November 1963 examinations or earlier, will be permitted to appear in the respective Sections under the existing scheme up to November 1964.

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Revision of IS : 772-1956, Specification for General Requirements of Enamelled Cast Iron Sanitary Appliances—Doc : BDC 3(603).

This Standard lays down the general requirements, such as material, thickness, warpage, enamelling, acid and alkali resistance, inspection rules and marking, for enamelled cast iron sanitary appliances like water closets and commodes.

2. Draft Revision of IS : 773-1956, Specification for Enamelled Cast Iron Water Closets, Railway Coaching Stock Type—Doc : BDC 3(603).

This Standard lays down the general requirements for material, workmanship, manufacture, dimensions and finish of enamelled cast iron railway type water closets generally used in the coaching stock of Indian Railways.

3. Draft Revision of IS : 775-1956, Specification for Brackets and Supports for Lavatory Basins and Sinks—Doc : BDC 3(605).

This Standard covers requirements with regard to materials, construction and workmanship, dimensions, weights and finish of cast iron and mild steel brackets and supports for lavatory basins and sinks.

4. Draft Revision of IS : 776-1957, Specification for Water Closet Seats and Covers—Doc : BDC 3(606).

This Standard covers requirements with regard to materials, manufacture, dimensions, finish and testing of seats and covers for use with water closets.

Members may send their comments on the above draft Standards before April 25, 1962, to Shri N. V. Modak (*M.*), 'Udyam', Shivaji Park, Bombay 28, who is the Institution representative on the Sectional Committee dealing with these draft Standards.

Copies of the draft Standards may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 2/21 First Line Beach, Madras 1; or 14/69 Civil Lines, Kanpur.

FORTHCOMING CONFERENCES

Symposium on 'Corrosion of Metals', Ministry of Defence, Kanpur, November 7-10, 1962

A Symposium on 'Corrosion of Metals' will be held at the Defence Research Laboratory (Stores), Kanpur, from November 7-10, 1962, just prior to the Golden Jubilee celebrations of the Defence Laboratory and allied Stores Division Establishments of the Ministry of Defence. It is proposed to cover the following subjects in the Symposium :

(i) Fundamental studies on corrosion ;

(ii) Corrosion inhibitors ;

(iii) Non-metallic protective coatings ;

(iv) Metallic coating and paints ;

(v) Corrosion problems in industries ;

(vi) Environmental studies, *e.g.*, corrosion in atmosphere, soil, immersed conditions, and at high temperature ;

(vii) Laboratory methods of corrosion testing ;

(viii) Special corrosion problems ;

(ix) Practical corrosion problems ; and

(x) Cathodic protection.

Further details regarding the Symposium can be had from the Director at the above address.

Symposium on 'Flameproofing, Intrinsic Safety and Other Safeguards in Electrical Instrument Practice', London, April 27, 1962

A Symposium on 'Flameproofing, Intrinsic Safety and Other Safeguards in Electrical Instrument Practice' is proposed to be held at London on April 27, 1962, under the auspices of the Institution of Electrical Engineers, London. The scope of the Symposium includes modern methods of operating and designing electrical instruments, apparatus and control devices in hazardous and explosive atmospheres, and a general review of the importance of this subject. The Organizing Committee welcomes submission of papers for the Symposium and requires prospective authors to inform the Secretary of the Institution without delay.

Further details of the Symposium will be available from the Secretary, Institution of Electrical Engineers, Savoy Place, London W.C. 2.

LIST OF NEW ELECTIONS AND TRANSFERS

(Continued from the Bulletin for November 1961)

MEMBERS

No.	Name
2478	Pritam Chatomal Vasandani*
2479	Srinivasiengar Ramiengar*
2480	Pran Nath Malhotra*
2481	Hiremagalur Venkatadasappa Gopalakrishna*
2482	Amal Kumar Roy*
2483	Sachindra Prasad Saha*
2484	Maj. Joseph Theodore Rajaratnam David*
2485	Natabar Siddhanta*
2486	Guruvayur Subramaniam Ramaswamy*
2487	Muhammad Intasaruddin Haquani
2488	Dorab Pestonjee Maneckjee Kanga
2489	Leslie Cameron Richards
2490	Dr. Harbans Lal Uppal
2491	Gangadharapuram Krishnamurti Ramamurthi*
2492	Sri Ram Singh*
2493	Ram Swarup Chaturvedi*
2494	Pritamdas Bulchand Shahani*
2495	Dinesh Mohan*
2496	Amarendra Chandrashankar Pandya*
2497	Thakorlal Muljibhai Desai*
2498	Lt.-Col. Bimalendu Goswami*
2499	Bibhuti Bhusan Dutta
2500	Tharmavaram Sundaramurthy Chokkanadhan
2501	Ganesh Sadashiv Thosar*
2502	Arjandas Bulchand Chandiramani*
2503	Gopal Das Agrawal*
2504	Ramaswami Venkataraman*
2505	Vishwanath Vishnu Sarwate*
2506	Baldev Issardas Bhambhani*
2507	Capt. Jamshedji Navroji Mullan*
2508	Garladinne Janaki Ram*
2509	Christopher James Tylee
2510	Robert Oliver Thomas
2511	Bistu Poda Sen Gupta*
2512	Krishna Kamal Chakravarti*
2513	Kali Charan*
2514	Mysore Raghavendra Rao Krishnamurti Rao
2515	Shadi Ram Sharma
2516	Homi Nusserwanji Sethna
2517	Kaikhusru Dinshah Kapadia*
2518	Gokal Chand Arora
2519	Chockappa Subaroya Parthasarathy*

ASSOCIATE MEMBERS

No.	Name
9672	Rameshchandra Hiralal Jhaveri
9673	Amiya Kumar Dhara
9674	Nanubhai Harilal Shah
9675	Kailash Chand Nayar
9676	Biswa Ranjan Choudhury
9677	Parimal Kumar Gupta
9678	Hari Chand Chopra
9679	Dr. Viruru Subbarao Subbarao
9680	Dr. Dhano Dandumal Jotwani
9681	Himatlal Somabhai Shah
9682	Jagdishchandra Mulshanker Bhatt
9683	Hosabali Ramaswamiiyengar Bhashyam
9684	Babulal Balkrishna Shah
9685	Keshavmurthi Vyasmuthya Chari
9686	Girindra Narayan Khataniar
9687	Rohitkumar Rewashanker Shah
9688	Krishna Kumar Mishra
9689	Suresh Chander Arya‡
9690	Arun Kumar Ghosh†
9691	Chintamani Ramamurthy Nagaraj†
9692	Jai Prakash Gupta†
9693	Arun Chandra Talwani
9694	Budda Venkatarama Reddy‡
9695	Kantilal Popatlal Shah
9696	Anant Sakharam Vidwans
9697	Capt. Baldevinder Singh Sobti

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* Transferred from Associate Member

† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
9698	Sachchidanand Jayaswal
9699	Hri Prakash Kuchhal
9700	Tulsidas Mohanlal Sanghavi
9701	Capt. Prabhakar Raj Bahuguna
9702	Vasant Shankar Vaidya
9703	Balvant Harakchand Vora
9704	Madan Lal Nichani
9705	Laxman Sakharam Sane
9706	Maj. Rajendra Prashad Varma†
9707	Vitthal Rajaram Joglekar
9708	Bhaskar Dattatraya Shiwalkar
9709	Kamalakar Narayan Rajapurkar
9710	Padmanabh Vishwanath Bhutkar
9711	Vishnu Maheshwar Jog
9712	Thottiam Natarajapillai Rajendran‡
9713	Shrichandlal Kishinchand Ahuja
9714	Mysore Shamarao Gopal
9715	Narinder Nath
9716	Chittur Suryanarayanasetty Kanakadas
9717	Pandurang Vinayak Apte
9718	Chintamani Seturao Satyanarayana Rao
9719	Shaik Mastan Vali
9720	Krishna Ramchandra Datye
9721	Rameshwar Dayal Verma
9722	Achyut Gangadhar Patwardhan
9723	Capt. Vittalapura Narayanavadhani Ranganathan
9724	Panchapakesan Kalyanasundaram
9725	Lt. Shyamalendu Ganguly
9726	Gopalaiyer Ramanathan
9727	Anirudha Prasad Singh
9728	Capt. Venugopal Kasturi Raj
9729	Pandurang Bhagawan Diofode
9730	Nelamutala Nageswara Rao
9731	Lt. Krishna Mohan Agarwala‡
9732	Braj Bhushan Jain
9733	Capt. Gajanan Raghunath Dani
9734	Capt. Chandra Prakash
9735	Capt. Jagdishwar Lal Tuli
9736	Capt. Shyamal Ghosh
9737	Capt. Mahendra Singh Gosain
9738	Bhagirat Lal Gupta†
9739	Krishna Swaroop Gupta
9740	Capt. Arkalgund Putturao Ramachandra Rao
9741	Bantwal Somanath Mallya
9742	Capt. Mahendra Pal Kohli
9743	Narsingrao Vyankatrao Ratnalikar
9744	Capt. Dayal Mohan Gupta
9745	Dattaram Gopal Kadkade
9746	Arvind Madhav Ranade
9747	Arjun Singh Kapoor
9748	Capt. Gour Kanti Sen
9749	Dalpatlal Keshavlal Parikh
9750	Shrinivas Hari Chippalkatti
9751	Narhar Balkrishna Joshi
9752	Capt. Nurani Harihara Sundaresan
9753	Jaffar Yahyabhai Shipchandler‡
9754	Dr. Purushottam S. Dravid‡
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9756	Bandiatmakur Bindumadhava Rao
9757	Mohammad Yasin Ansari
9758	Rampalli Anjaneya Sastry
9759	Kandasamypillai Srinivasan
9760	Kalpatty Vydianathan Swaminathan
9761	Capt. Pandurang Ganesh Thosar
9762	Mohamed Bahavudeen Abdullah
9763	Kartarsingh Dharamsingh Sokhey†
9764	Capt. Rajendra Nath Mehrotra
9765	Jai Chand Jain‡
9766	Manohar Lakshman Dongre
9767	Pralhad Ramrao Kulkarni†
9768	Madhukar Tukaram Korde
9769	Prabhakar Bhaskar Papalkar
9770	Gadangi Balakrishna
9771	Chandrashekhar Bhaskar Kagalkar
9772	Uchila Navada Parameshwar Rao
9773	Anant Ram Iyer
9774	Capt. Prem Sagar Bakshi
9775	Pundalik Vidyadhar Garde
9776	Deokinandan Shyamlal Tiwari
9777	Capt. Ranbir Singh Thapar
9778	Harihar Suryanarayan
9779	Mohan Khubchand Chandnani
9780	Somasundaram Valliappan
9781	Bhagwat Swarup Mital

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† Transferred from Students

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
9782	Capt. Mahinder Nath Gulati
9783	Capt. Chethpet Varadaraj Satyanarayan
9784	Capt. Kallivalappil Varunny Jolly
9785	Devendra Kumar Laroia
9786	Kanchanbhai Raojibhai Amin
9787	Kashi Nath Joshi‡
9788	Nittoor Sreenivasarau Subbanna
9789	Shyama Pada Patra
9790	Capt. Ashoka Puri
9791	Gopinath Narayanrao Paraki
9792	Motilal Bhikamchand Jain
7993	Dattatreya Vinayak Dandage
9794	Ashok Kumar Dhol‡
9795	Pandipati Latcha Reddy
9796	Vishweshwar Marotrao Dawle
9797	Chandrakant Pranjiwandas Desai
9798	Capt. Ramchandra Sadashiv Pethe
9799	Narsimhiah Laxminarsimhiah
9800	Kishor Prabhakar Dharap†
9801	Bishan Chand Gupta‡
9802	Wg.-Cdr. Darashaw Jehangir Lawyer
9803	Capt. Pritam Singh Pannu
9804	Capt. Surinder Mohan Chadha
9805	Radhey Shyam Agarwal‡
9806	Satyendra Nath Phukan
9807	Sudhijit Datta
9808	Suraj Narain
9809	Krishnasamy Selvaraj David
9810	Mukkanna Parappa Asangi
9811	Shreeram Kashinath Damle
9812	Ghooli Srinivasa Murti
9813	Raghuveer Mangeshrao Dhareshwar
9814	Janardan Ramchandra Patwardhan
9815	Chimanbhai Dahyabhai Desai
9816	Pramodchandra Raghunathrao Bhave
9817	Girwar Prasad Agrawal
9818	Bansilal Ranchhoddas Shah
9819	Vidya Ratna Jha
9820	Muthunarayana Dasaratharama Reddy‡
9821	Capt. Belur Keshaviengar Ramakrishna
9822	Sosale Krishnarao Anantharama Rao
9823	Sundar Prakash Sangal
9824	Krishna Swaroop Goyal
9825	Bhavdish Prasad Jain
9826	Chandra Prakash Sharma
9827	Jayantkumar Manilal Mehta
9828	Govindan Jinarajan
9829	G. Manickaraj
9830	Capt. Ranbir Singh Kalra
9831	Premanand Purushottam Dharwadkar
9832	Fg.-Off. Vaidyanathan Balasubramanian
9833	Kutticatt Giri Narayanan
9834	Shivajirao Ganpatrao Bhosale
9835	Pradyumna Ratilal Gandhi
9836	Avtar Singh
9837	Ram Kishor Gupta
9838	Dolarray Chimanlal Shah
9839	Madhusudan Keshavram Shastri
9840	Navanitlal Chunilal Shah
9841	Harihara Srinivasan
9842	K. M. Kantawala
9843	Sqn.-Ldr. Kyatnahalli Nanjappa Rama Swamy
9844	Provat Kumar Mukerjee
9845	Anandamoy Bhattacharyya
9846	Manmohan Batra‡
9847	Satyesh Ranjan Mukherjee
9848	Capt. Raghavan Vijaya Raghavan
9849	Indu Bhusan Mittra
9850	Prodyot Kumar Das
9851	Kishori Mohon Das Gupta
9852	Rabindra Nath Chakraverty
9853	Maddury Subba Rao
9854	P. Ramakrishna Rao
9855	Kadathur Suryanarayanaiyer Bikshandeswaran
9856	Flt.-Lt. Arun Kumar Roy
9857	Dr. Amarendra Krishna Roy
9858	Bhagu Mulchand Lalvani
9859	Nripendra Chandra Hazarika
9860	Sarweswara Somayajulu Yechury
9861	Nitish Narayan Roy
9862	Vijay Krishna Sharma
9863	Romeshchander A. Khanna
9864	Rudraji Shanker Kenkre
9865	Capt. Arumukhampillai Subramonia Pillai

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‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
9866	Capt. Krishnan Kumaran
9867	Capt. Satya Prakash
9868	Flg.-Off. Ballianda Biddayya Appachu
9869	Bangalore Subrahmanyajois Krishna Murthy
9870	Capt. Om Parkash Kohli
9871	T. P. V. Rajan
9872	Lokeshwar Raj Sharma‡
9873	Sohrab Ardeshir Ghiste‡
9874	Vinay Chaturdas Shah
9875	Lt. Inder Lal Bhatia
9876	Capt. Manabendra Kishore Paul
9877	Madhava Krishna Pulusekar
9878	Capt. Jitendra Prakash Sharma
9879	Jagdish Saran Misra
9880	Tapan Kanti Roy
9881	Krishnalal Sunderlal Parikh
9882	Prabodhchandra Vadilal Shah
9883	B. Srinivasaiyengar Prasanna
9884	Shantilal Ganpatram Panchal
9885	Gokaldas Kantilal Parikh
9886	Edward Manuel‡
9887	Shashikant Maganbhai Patel
9888	Mihir Ranjan Lodh
9889	Mukul Gupta
9890	Capt. Amarjeet Singh Gill
9891	Capt. Gurdev Singh Ahuja
9892	Gopalakrishna Sundararajan
9893	Man Mohan Fotedar
9894	Debabrata Ghosh
9895	Neelkanth Raghunath Patwardhan
9896	Pappu Subrahmanyam
9897	Cheruvu Sambasiva Sastry
9898	Khalifulla Kutbuddin
9899	Soorenahalli Narasimhamurthy Narasinga Rao
9900	Hurshvadan Harishchandra Parikh
9901	Pran Nath Bhusry
9902	Lachhman Balchand Ahuja
9903	Bimal Kumar Mullick
9904	Shriniwas Pandurang Desai
9905	Satyendra Chandra Das
9906	Capt. Paul Varghese
9907	Capt. Satish Kumar Chawla
9908	Padmakar Sadashiv Khirwadkar
9909	Ravi Kaleswara Rao
9910	Premjibhai Damjibhai Devani
9911	Kavil Narayanan Narayanan
9912	Capt. Prithvi Raj
9913	Kashinath Madhav Shinde
9914	Ravindra Nath Singhal
9915	Viswanathan Raman
9916	Capt. Mulk Raj Sikka
9917	Jatindra Nath Kalia
9918	Capt. Vishwa Nath Rai
9919	Cunnumpurathu Abraham
9920	Venkatarama Subramanian
9921	Ramesh Kumar Abrol
9922	Karunakara Raja Gopala Menon
9923	Hirendra Nath Batavyal
9924	Capt. Devinder Kumar Chandhok
9925	Susanta Kumar Ghosh
9926	Capt. Edamanal Srinivasa Krishnamurthy
9927	Capt. Rajarajavarma Nandakumara Varma
9928	Tilak Raj Sethi
9929	Martand Krishnarao Bagal
9930	Ambadas Pandharinath Dhande
9931	Madhav Govind Apte
9932	Vasant Marotrao Sakharkar‡
9933	Vasant Yadaorao Koli
9934	Capt. Subramanian Narasimhan Iyer
9935	Om Prakash Vaish
9936	Baldev Raj Julka
9937	Bhamidipati Venkata Ramana Murty
9938	Kavuru Anantha Ramarao
9939	Maj. Krishna Murti Raina
9940	Capt. Joginder Singh
9941	Fg.-Off. Kollengode Seshu Balasubra Mani‡
9942	Digavalli Seetharama Rao
9943	Maj. Prem Nath Gupta
9944	Capt. Elappupara Krishnan Nair Kumar
9945	Joydev Chandra Das
9946	Capt. Sushil Kumar Suri
9947	Prodyot Kumar Patra
9948	Muddapu Sundara Rao

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† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
9949	Dharmendra Kumar Gupta
9950	Satya Prakash Khanna
9951	Capt. Yash Pal Diwan
9952	Chelikani Venkata Jagannatha Varma
9953	Mohamed Abdul Manan
9954	Shridhar Raghunath Joshi
9955	Surinder Kumar Bahl
9956	Doola Rama Rao
9957	Guda Surya Narayana
9958	Capt. Bharat Bhushan Rajpal
9959	Capt. Pappu Sivaprasada Sarma
9960	Vimal Kumar Jain
9961	Babubhai Chhotalal Mehta
9962	Rameshchandra Ramanlal Mehta
9963	Flt.-Lt. Santokh Singh Sachdeva
9964	Bansidhar Shantilal Lekhadia
9965	Indravadan Gordhandas Shah
9966	Biharibhai Dahyabhai Patel
9967	Arvindkumar Chandulal Shah
9968	Thakorlal Hiralal Shah
9969	Ramesh Narsinhdas Soni
9970	Prafulla Adityaram Thaker
9971	Kanaiyalal-Jivanlal Daftari
9972	Vishwanath Narayan Nayak
9973	Rameshchandra Balvantrao Shah
9974	Bhupendra Bhukhandas Gajjar
9975	Amritlal Jhaverchand Mair
9976	Mayoor Shantilal Patel

No.	Name
9977	Arthur Richard Cyril Sandys
9978	Shreekant Gajananrao Tatu
9979	Eknath Vishnu Ghate
9980	Arumkumaram Ramanathan Jagannathan
9981	Prabodhchandra Chimanlal Shah
9982	Ramanlal Ashabhai Patel
9983	Rameshchandra Chandulal Shah
9984	Girishchandra Ambalal Mahadevia
9985	Jitendralal Surendralal Suteria
9986	Rashmikant Bhailal Doctor
9987	Pravinchandra Ramanlal Shah
9988	Basaveshwar Chanabasappa Khanapuri
9989	Capt. Girish Mohan Kamra
9990	Divyendu Narayan
9991	Vishnubhai Narandas Soni
9992	Prabhakar Bhagirath Pawar
9993	Flg.-Off. Omkar Singh Gupta
9994	Capt. Surendra Verma
9995	Hari Krishna Agrawal
9996	Shanker Dutt
9997	Balram Narain Kapoor†
9998	Piyush Bhikhabhai Jani
9999	Venkateshavadhani Sreekantiah Nagaraja
10000	Chimanlal Keshavlal Shah
10001	Kanubhai Shakarabhai Shah
10002	Chandrakant Himatlal Shah
10003	Ardhendu Shekhar Majumdar

GRADUATES

No.	Name
1395	Madhusoodan Hiralal Bhatt
1396	Sub.-Lt. Venkatray Narayan Kamath
1397	Sub.-Lt. Shridhar Raghunath Deshpande
1398	Ranjit Kanti Datta
1399	Manohar Mal Bhandari
1400	Cpl. Kolukula Hema Sunder Rao†
1401	Devi Prasad Sharma†
1402	Ramarao Guru Rao
1403	Samir Kumar Chakravartti†
1404	Messiahdoss Soundraraj Godwin Davis†
1405	Vinayak Rakrishna Deshpande
1406	Sattiraju Ramajogeswara Rao†

No.	Name
1407	Vuppala Gouri Ramalingam†
1408	K. C. Rama Varma Raja†
1409	Dipankar Das†
1410	Bulusu Venkateswarlu
1411	Harendra Nath Gupta
1412	Krishna Narayanan†
1413	Manohar Lall Kaura†
1414	H. M. Sreenivasa Rao
1415	Dwijendra Kumar De†
1416	C. Ponnurangamudaliar Ranganathan
1417	V. Narayanaiyengar Dwarakanath
1418	Darshan Lal Chawla†

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† Transferred from Student.

GRADUATES (*contd.*)

No.	Name	No.	Name
1419	Hariharapuram Rangachar Krishnaswamy	1437	Ramashankar Parasnath Pande†
1420	Mahindra Partap Mahajan	1438	Durairaj Gunasekaran Daniel†
1421	Narayana Ramanathan	1439	V. Ramamurthi†
1422	Rajeshwar Prasad Goel†	1440	Mallipamula Venkata Ramana
1423	Daivasagamoney Sugantharaj	1441	Lt. M. Ramaswamy Satchithanandham†
1424	Chakravarthy Varadan†	1442	Puthezhath Viswanatha Menon†
1425	Kasiviswanatha Krishnan†	1443	Chaman Lal Bhasin†
1426	Amarendra Nath	1444	Madan Dattatreya Sawai
1427	Rajendra Prasad Mathur†	1445	Madhav Ramchandra Bapat†
1428	Pritam Singh Murvey†	1446	Kavi Raj Chugh†
1429	Om Behari Shorawal†	1447	Satish Saxena
1430	Kishin Bhambhani	1448	Manohar Singh†
1431	Gollakota Vijaya Mohan	1449	Karpal Singh Bhati
1432	Kotachery Anantha Kamath†	1450	Mahuk Singh†
1433	Krishna Kumar	1451	Surendra Kumar Jain
1434	P. A. C. Kasirajanadar Pavalam	1452	Ayyagari Jagadish Chandra
1435	Prodosh Kumar Moitra	1453	Lakshmi Shanker Prasad
1436	Farrokh Rustomji Tata†	1454	Vasant Bhaskar Pandit

CORRIGENDUM

TO VOL. 11, NO. 6, FEBRUARY 1962

Page 30. Under 'Misdemeanour in the Institution Examinations', instead of 'The council have decided to cancel the result of the following candidates for the May 1962 examination....', please read 'The council have decided to cancel the results of the following candidates for the May 1961 examination....'.

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† Transferred from Student.

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A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

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Duties : Operation and maintenance of modern steam power station of 20,000 kW capacity.

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Salary : Emoluments in excess of Rs.1,000 per month with perquisites. Prospects of eventual promotion to higher positions, carrying emoluments of Rs. 2,000 per month for capable and energetic men.

All applications will be treated in confidence. (Office ref. E.S. 101)

Wanted an engineer to supervise manufacture of bottom bracket axles or bicycles on six spindle automatic machine. Should know about case hardening also. Experience about dies and jigs will be considered added qualifications. Apply terms to : Deepak Industries, Gill Road, Ludhiana.

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THE BULLETIN
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(effective June 1961)

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		Frequency per year	January	February	March	April	May	June	July	August	*September	October	November	December
Bulletin	*BU*	12	BU_5	BU_6	BU_7	BU_8	BU_9	BU_{10}	BU_{11}	BU_{12}	BU_1	BU_2	BU_3	BU_4
Civil Engineering Division Part	*CI*	6	CI_3		CI_4		CI_5		CI_6		CI_1		CI_2	
Mechanical Engineering Division Part	*ME*	6	ME_3		ME_4		ME_5		ME_6		ME_1		ME_2	
Electrical Engineering Division Part	*EL*	6		EL_3		EL_4		EL_5		EL_6		EL_1		EL_2
Electronics & Tele-communication Engineering Division Part	*ET*	3	ET_2				ET_3				ET_1			
Chemical Engineering Division Part	*CH*	3		CH_2				CH_3				CH_1		
Mining and Metallurgy Division Part	*MM*	3			MM_2				MM_3				MM_1	
General Engineering Division Part	*GE*	3				GE_2				GE_3				GE_1
Hindi Section	*HI*	3				HI_2				HI_3				HI_1

Figures appearing as subscripts indicate issue numbers.

* A new volume commences in September each year and ends in August next year.

THE LARGEST SOLAR FURNACE IN THE WORLD

R. Aron
Non-member

Of all times, men have sought to use the sun as a source of energy. During antiquity, it is known that the Egyptians and the Incas used mirrors to cook the offerings given to the gods. Buffon, an 18th century French naturalist, succeeded in firing coal by juxtaposing a number of flat mirrors. Lavoisier, the great chemist, succeeded in melting wrought iron with the help of lenses. Moreover, at the International Exhibition of 1878, an astute inventor, Mouchot, succeeded in operating a printing press by means of solar energy and thus printed 500 copies per hr. of a newspaper which he called '*Le Soleil*' ('The Sun').

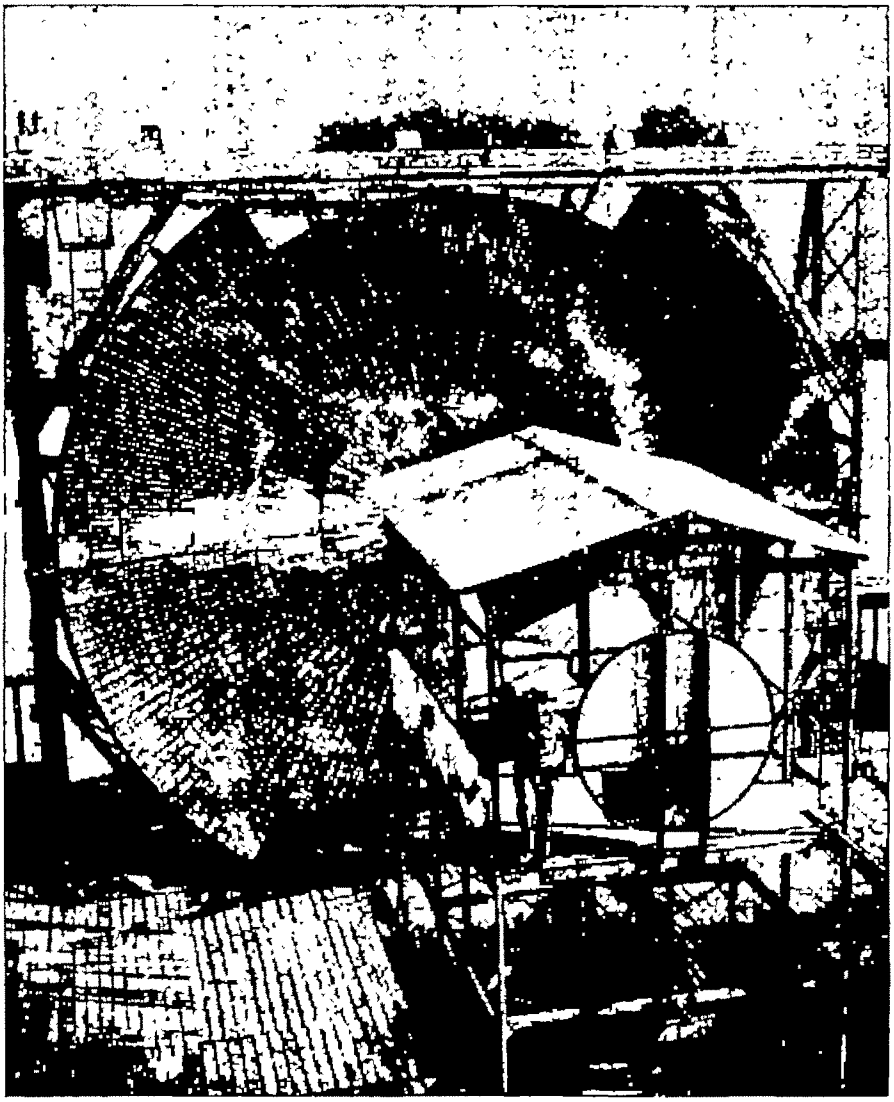
These were only amateur undertakings meant to intrigue the curiosity of people rather than to obtain practical results. It was necessary to await the beginning of the 20th century in France before solar energy could be applied to industrial uses.

In 1946, Félix Trombe, a chemist who was a specialist in rare earths, succeeded in making the first French solar furnace operate at Meudon, near Paris. The equipment was difficult to handle and elementary in design. It consisted of a mirror pointed in the direction of the sun and pivoting on itself in order to follow the course of the sun. The rays which it received were parallel, and, therefore, it was necessary to reflect them and make them converge on one spot where a temperature of about 3,000°C. was attained. This was an interesting result, but the spot continually moved during the day, making it very difficult to use the energy thus produced. In addition, the persons using the mirror had to move it by hand which involved the risk of burning their eyes.

Three years later, the same crew, directed by Félix Trombe, set up another solar furnace on a slope in the western Pyrénées at Montlouis. This region has more sun than Meudon, and this was a natural advantage. Félix Trombe made more progress at Montlouis as compared with his earlier achievement at Meudon. The temperature obtained was more than 3,000°C, which enabled melting of large quantities of refractory oxides used in industry for the production of crucibles and furnaces. This furnace was equipped with automatic regulatory devices which required no human handling. Solar rays were first received on a flat mirror with a surface area of 135 m^2. This mirror was called a 'heliostat'. The heliostat automatically directed the rays towards a parabolic mirror which made them convergent. Almost one year was needed to regulate the 3,500 mirrors which made up the heliostat. This was carried out at night under difficult conditions, since during the day the scientists would have burnt themselves.

Today, the solar furnace at Montlouis, which operates regularly, is considered as an old model. In the same region at Odeillo, near Font-Romeu, Trombe is preparing a new model which will be completed in three years and whose power will be considerably larger than the solar furnace at Montlouis. It will be the largest solar furnace in the world. It will be a reproduction on a larger scale of its predecessor at Montlouis and will be 20 times as powerful. The parabolic mirror on which the solar energy will be concentrated will be 54 m. long and as high as a 12-storey building. It will be able to supply energy equivalent to 1,000 kW, but its industrial possibilities will be even greater. It is so planned as to be able to treat two to three tons of refractory oxides a day.

Such projects are followed with great interest by the countries of Africa which have become independent newly. Rich in minerals but poor in energy, the majority of these countries are favoured by considerable sunlight. As Mr. Edouard Lannes concludes in a recent article in the review '*Science et Vie*', 'the solar furnace could well be for them the ideal solution needed for progress'.



Solar furnace at Mountlouis

FUSION POWER

N. F. Jesung
Student

General

This paper presents basic concepts of fusion and illustrates to a limited extent the major difficulties in producing controlled thermonuclear reactions to give immense power from a fuel which is available in unlimited quantity, *viz.*, sea water.

Fusion is the formation of heavy atoms by the combination of light atoms, and the process was demonstrated in an experimental bombardment with high speed particles as early as in 1919. Following the first experiments on fission in 1939, scientists utilized the high temperature and energy available from atomic fission to initiate fusion reaction in the hydrogen bomb. Energy release from the hydrogen bomb is instantaneous and uncontrolled, and hence useless for peaceful purposes.

To start a fusion reaction, nucleii of very light materials are brought very close to one another against an electrostatic repulsion force. These nucleii must have very high energy to overcome this force of repulsion. This energy corresponds to a temperature rise of the order of millions of degrees. No known material can withstand such high temperatures. This stream of fused nucleii, called 'plasma', is kept at the centre of the vessel with the help of a magnetic field. This process requires very large currents and voltages and, therefore involves costly equipment. As the nucleii employed for such reactions should be of the light type, the isotopes of hydrogen are considered to be the most suitable fuel. These are available in large quantities in sea water.

The theory of nuclear fusion given by Cockcroft and Walton in 1932-33 was developed by Prof. Oliphant. But, it was only after the Geneva Conference in 1955 and the lecture delivered by the Russian scientist, Dr. Kirchatov, at Harwell in 1955, that the veil of secrecy on fusion was lifted.

Fusion process is in many respects the opposite of fission, about which much is known nowadays. Fission is the splitting of heavy uranium nucleii, whereas, in fusion, very light nucleii are coalesced to produce heavier and more tightly bound nucleii. A study of the binding energy values for the nucleii involved in such reactions is presented here to explain how liberation of energy is achieved in such reactions.

Binding energy

When several particles combine into a nucleus, energy equivalent to the binding energy is released. A nucleus always possesses lesser energy than the sum of the energies of the individual free particles comprising it. The more the energy released in the formation of a nucleus, the more stable is the nucleus, and more energy is required to break it into its component parts.

A curve giving specific binding energy, *i.e.*, binding energy per particle, *vs.* mass number, called 'binding energy curve', is shown in Fig. 1.

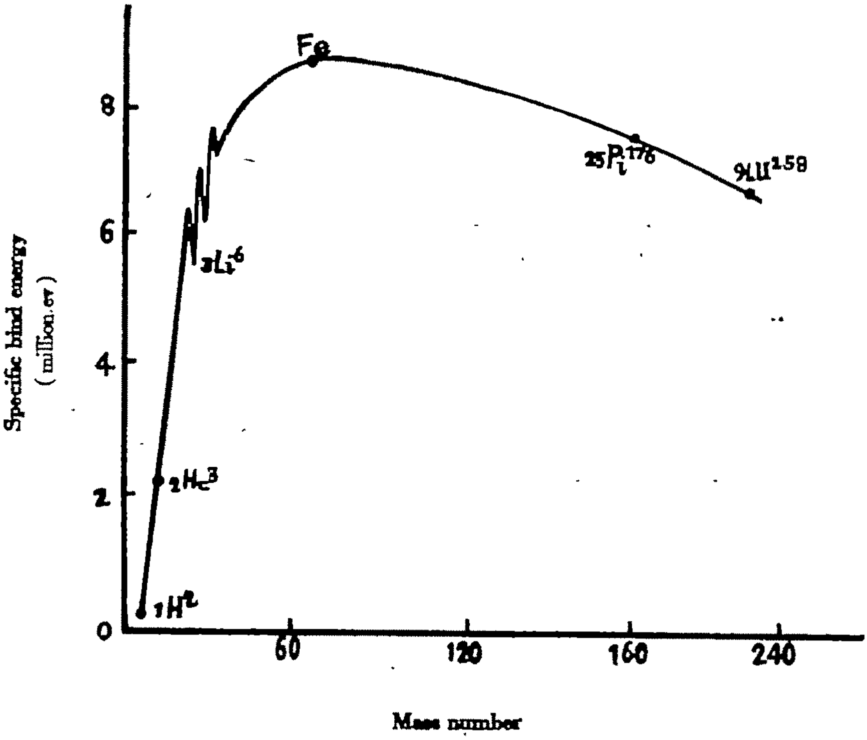


Fig. 1

Binding energy curve

From this curve, it will be seen that the most stable nucleii (in the neighbourhood of iron) contain 100 to 150 nucleons and have a specific binding energy of 8.4 to 8.6 million eV.

The specific binding energy of light nucleii such as hydrogen or helium is less than medium-nucleii. Therefore, nucleii with less binding energy can be made to release energy if they are coalesced into other nucleii with higher binding energy.

Some of the most promising fusion reactions on which work is being done at present are

$$D + T \rightarrow He^4 + n + 17.6 \text{ million eV} \qquad (1)$$

$$D + D \begin{cases} \nearrow He^3 + n + 3.2 \text{ million eV} \\ \searrow T + p + 4.0 \text{ million eV} \end{cases} \qquad (2)$$

Requirements of fusion

As mentioned earlier, the nucleii must have very high velocities so that the electrostatic repulsion can be overcome and the nucleii can approach sufficiently close to one another for the nuclear forces to act. At such high velocities and energies, the chances of elastic scattering are greater. It is, therefore, essential that the nucleii are confined to a limited region and made to approach one another repeatedly until fusion of at least some of them takes place.

At very high temperatures, all the fuel atoms are completely stripped of their electrons to form ionized gas or plasma. This plasma consists of charged nucleii and electrons which constantly collide and radiate energy at an appreciable rate. No plasma can stay at a high temperature if it radiates energy faster than that generated by fusion reaction. There is a fixed minimum temperature, called 'ignition temperature,' below which the reaction cannot sustain itself. This temperature is independent of the density of the plasma, and for $D + D$ reaction, it is of the order of 400,000,000 °K. Since the radiation losses increase as the square of the atomic number, the ignition temperature of fuels other than hydrogen isotopes is much higher. Even traces of heavier elements as impurity in the plasma result in substantial losses by radiation from the plasma.

At the high temperatures encountered in fusion reactions, no gas can be confined within the walls of a container made of any known material, as the walls will either vaporize or cool and quench the reaction. It is necessary to confine the plasma in a non-material container, possibly in a carefully controlled magnetic field capable of withstanding temperatures of the order of 100,000,000 °K.

Methods of igniting plasma

The problem of igniting the plasma can be tackled in a number of ways. A brief account of four major methods is given below.

In the 'pinch' method, a current of peak value between 100,000 and 2,000,000 amp. is passed through the gas. The magnetic force of the current tends to constrict or pinch the plasma towards the centre line of the tube and this results in a large increase in its density and temperature. In the U.S.S.R., a number of experiments were carried out with straight discharge tubes filled with gas at pressures varying from 0.005 mm. of mercury to atmospheric pressure, with length of gap up to 2 m. and diameter 5 to 60 cm. The rate of current rise was found to be between 10^{10} and 10^{12} amp. per sec.

Tuck has shown a method of igniting the plasma by transformer action in a circular tube. In this method, the primary winding of a transformer is wound round the tube and the plasma forms a single-turn secondary winding which is heated when the primary is supplied from a high voltage impulse generator. The apparatus has an iron core (Fig. 2).

In the Princeton stellarator, cold gas is confined by means of a very strong magnetic field. Initially, a small current is passed, and later, a larger current is caused to flow by transformer action. This brings the gas to a state where its electrical resistance is much less than the resistance of a solid bar of copper occupying the same space. The gas is then agitated by a strong alternating magnetic field. This process is called 'magnetic pumping'. Spitzer showed that under these conditions the gas drifts towards the walls, and this could be avoided by bending the doughnut into the shape as shown in Fig. 3 to minimize the losses. Later, to simplify the construction, the doughnut shape is retained and the losses are reduced by tailoring the magnetic field.

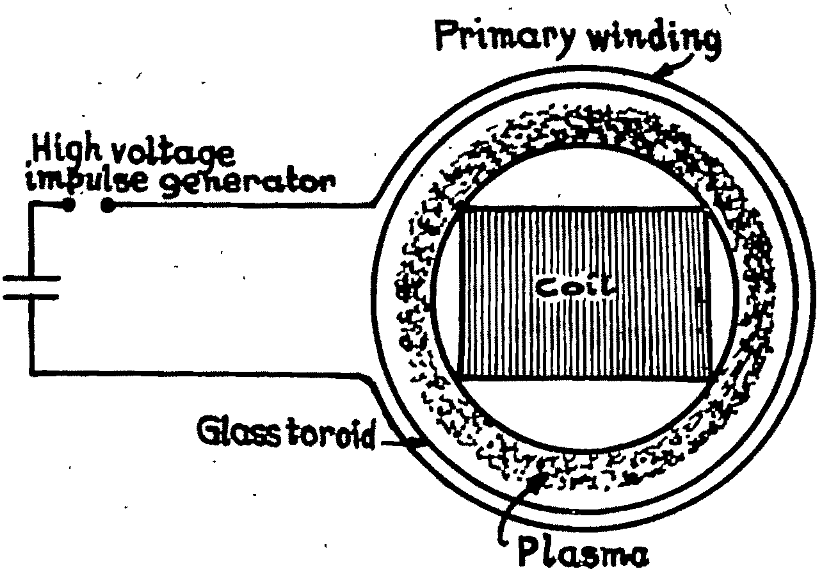


Fig. 2

Discharge in a circular tube

(an experimental technique for igniting the plasma)

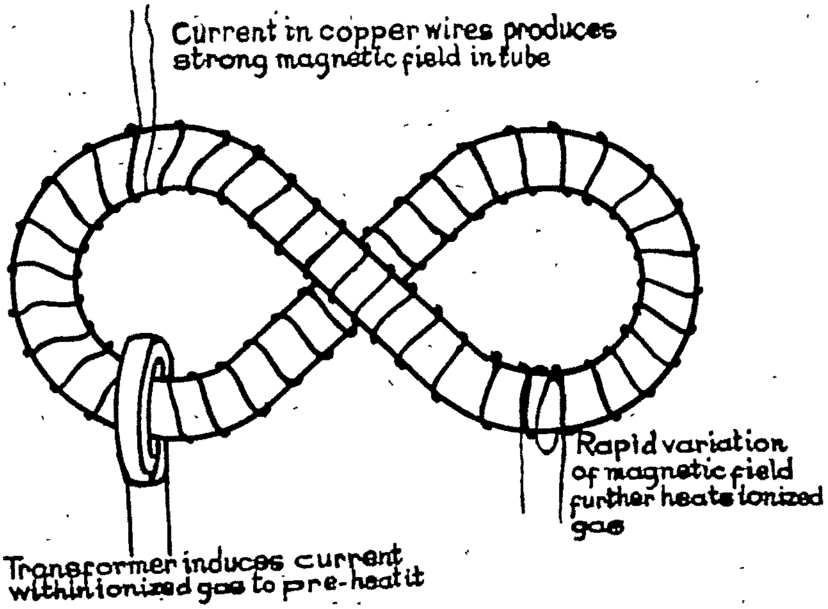

Current in copper wires produces strong magnetic field in tube
Rapid variation of magnetic field further heats ionized gas
Transformer induces current within ionized gas to pre-heat it

Fig. 3

An early concept of the stellarator

In Post's mirror programme, energetic ions and the accompanying electrons are injected into a strong field provided by two large coils. Initially, the ions travel in spirals nearly at right angles to the field. The current in the coils is then increased, which squeezes the hot gas. In some of the designs, it is possible to squeeze the gas radially and transfer it from one chamber to another.

Very hot plasma of low density has good confinement property, which is made use of by trapping the molecular ions inside the confined space. Each molecular ion breaks up into an atomic ion (deutron) and an atom of deuterium. These atoms tend to escape, but the hot ions are limited to smaller orbits and are made to circulate in the confining magnetic field. Luce showed that a high current, high vacuum arc dissociates molecular ions efficiently. So far, work on this method has been done with continuous injection into mirror coils with D.C. The apparatus used is called DCX. The Russian apparatus, OGRA, is based on this general principle, but does not use the arc.

By means of a plasma gun which projects ionized matter at speeds up to 7,500 miles per sec. into an externally excited magnetic field, plasmoids are produced. The plasma gun consists of two small wires embedded in a ceramic disc with their ends flush with the face. The wires are made of titanium containing absorbed deuterium. A 10,000 amp. arc is struck between the two ends which are heated to vaporize and ionize both titanium and deuterium. The temperature of deuteurim ions in these plasmoids reaches up to 4,000,000°K.

Another method of igniting the plasma is to apply one-dimensional shock waves in deuterium which produces a velocity of 5 to 25 cm. per μsec. by coupling an external magnetic field to a high voltage, low inductance charge.

Applications

Based on the principles stated above, a number of machines have been built. The important amongst these are the 'zeta' and the 'stellarator'. Besides these, Screptre III and the French 'Equator' are machines similar to Zeta.

Zeta

Zeta stands for zero energy thermonuclear assembly. It was built in Harwell by a young Australian, Dr. Thonemann. After two years of design and construction work, it started operating in August 1957.

Zeta is shaped like a thick motor car tyre made of aluminium, measuring about 10 ft. across. It is filled with deuterium. A large current is passed through this deuterium filled tube, which sets up an electric discharge heating the gas to very high temperature. The gas is confined to the centre of the tube with the help of large coils and this produces an intense magnetic field.

With this assembly, temperatures up to 5,000,000°C. were obtained, but these temperatures could be maintained only for two- to five-thousandths of a sec. During this small period, presence of neutrons was observed, but it was found that these neutrons were not the result of fusion. Their presence was due to scattering after collision between the fast and slow deutrons.

C-stellarator

The construction of C-stellarator is similar to zeta. It consists of a race track shaped stainless steel tube with windings which can withstand peak currents of the order of 700,000 amp, producing a field of 50,000 gauss around the stellarator.

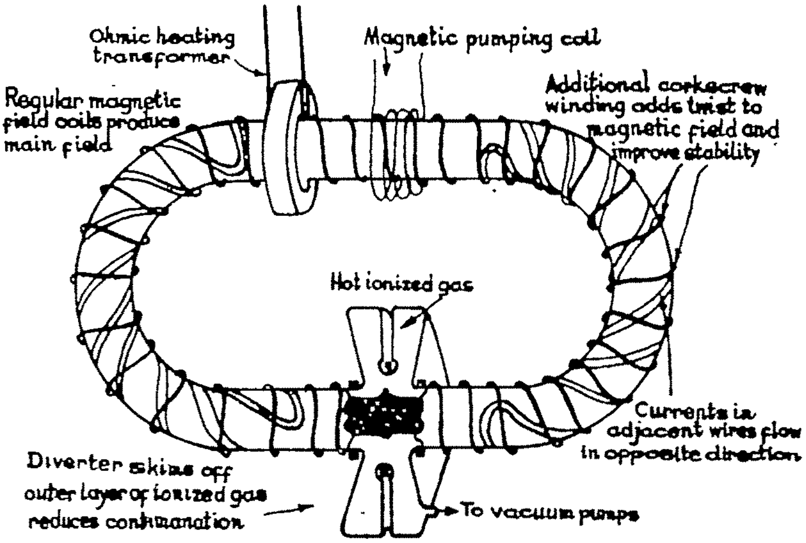

Ohmic heating transformer
Magnetic pumping coil
Regular magnetic field coils produce main field
Additional corkscrew winding adds twist to magnetic field and improve stability
Hot ionized gas
Currents in adjacent wires flow in opposite direction
Diverter skims off outer layer of ionized gas reduces contamination
To vacuum pumps

Fig. 4

C-stellarator

In the stellarator, a magnetic diverter skims off the outer layer of ionized gas to reduce contamination. The plasma is heated by radio frequency magnetic pumping and resonance heating. At the first stage, the gas, which is heated by transformer action, forms a short-circuited single turn. Ionization is achieved by imposing a pulse of energy at 40 to 100 k/cs at a breakdown voltage across the insulated portion of the stellarator tube for a period of up to 10 millisec. Second stage heating of the plasma is achieved by exciting it at frequencies tuned to match the natural frequency of rotation of its nucleii in the confining field. Because of the higher efficiency of this method of heating, the power output is of the order of 14 MW.

Conclusions

Fusion power can be obtained by any of the methods indicated here, preferably by installing a large unit, because a single large unit is considered to be capable of delivering heat equivalent to 1,000,000 MW in a single pulse. The plasma within the tube is burnt within a fraction of a second, after which the tube has to be charged with new plasma and voltage reapplied to bring it up to fusion temperature. Fusion power is a pulsed system, in contrast with the fission reactor in which the fuel charge lasts from three to five years and energy is produced continuously. It is difficult to say if, in future, fusion power will be generated more efficiently than in common nuclear plants, but there is an unlimited fuel source for fusion power in sea water which can be utilized for this purpose.

Contemporary World Engineering Projects Series—20

Members are invited to contribute to this Series special articles featuring major engineering projects which they may have visited or with which they may have been associated in any other manner. Articles should be preferably accompanied by photographs and illustrative sketches.

THE NIAGARA POWER PROJECT

S. Ananthaswamy

Non-member

General

The Niagara Power Project is the largest hydro-electric development in the western world, the total installed capacity in the two generating plants of the project being 2,190 MW. It is about two times bigger than the Sharavathi project in Mysore State, which will be the biggest hydro-electric power project in India with a combined installed capacity of about 1,000 MW.

The project makes use of the water in the Niagara River. Four of the five great lakes of North America flow into this river which in turn flows into Lake Ontario. Lake Ontario is connected to the sea through the St. Lawrence River. This forms the single largest waterway in the world, with a total hydel power development of nearly 8,000 MW.

Special features

The Niagara Falls is one of the world's great scenic attractions and hence this consideration has played a vital role in the development of power from the Niagara. A treaty was signed between Canada and the U.S.A. in 1950 that at least 100,000 cusec. of water must flow over the falls during the tourist season between April and October. At other times, the flow may be reduced to 50,000 cusec., the excess water being shared equally between the two countries. The treaty allows for water to be diverted for power generation during night after the tourist hours. A large storage reservoir to the east of the power plants is being built to facilitate storage of this excess water during the night and the usage of the same during the day for power generation.

Layout of the project

The Niagara River drops through 160 ft. at the falls, but it also drops nearly 50 ft. through the cataracts above the falls and about 115 ft. through the various rapids below the falls. To take advantage of this increased head, the intake works of the power plant are located about 2½ miles above the falls and the main generating plant, the Robert Moses power plant (named after the Chairman of the Power Authority of the State of New York) is located about 5 miles downstream. Thus, the average head on the turbine is nearly 314 ft., almost double the head available at the falls.

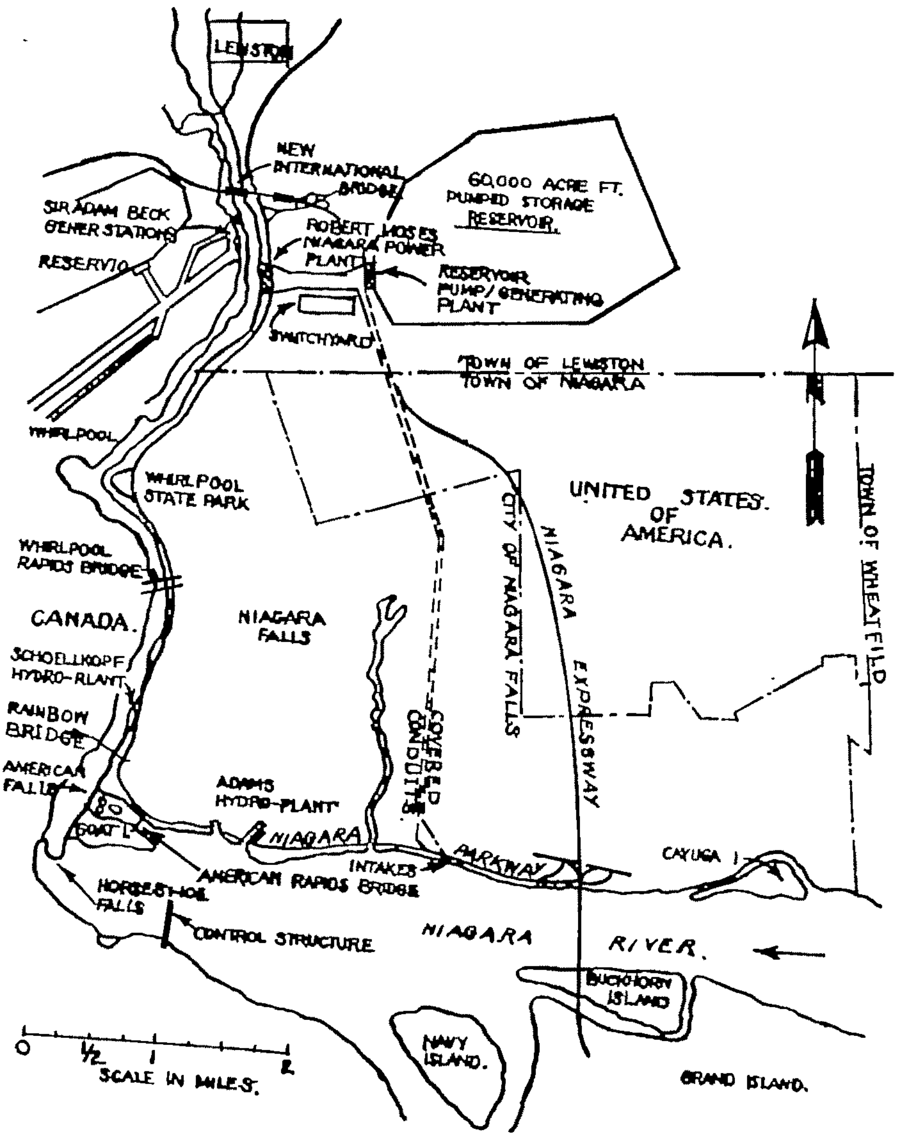


Fig. 1

General layout of the Niagara power project

From the intakes, water is taken through two underground conduits to the forebay. The storage reservoir is above the forebay and the pump-generator sets are installed at this point to pump the water into the reservoir during night and allow the same into the forebay for power generation during the day. A general layout of the project is shown in Fig. 1.

Intakes

The intakes consist of two reinforced concrete structures, each 700 ft. in length. Each of these contains 48 slotted openings whose tops vary from 13 to 26 ft. below the river surface (Fig. 2).

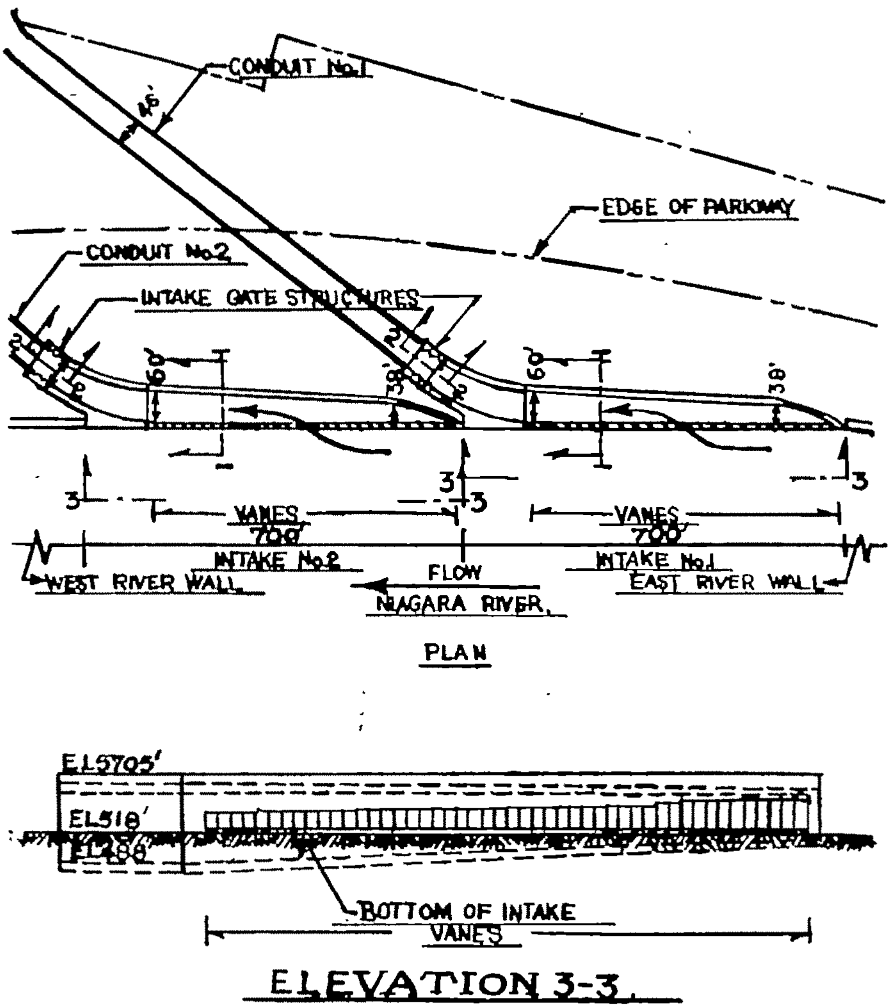


Fig. 2

ntake structures

The intake gate structure in each conduit contains a slot, 49 ft. × 68 ft., for a 400-ton vertical lift gate. The gate is 55 ft. wide and 100 ft. high, with an overlap of about 3 ft. between the slot and the edge of the gate. Another slot is provided in the conduit to enable stoplogs to be used in emergency in place of the gate. The river bottom along the shoreline downstream from the intake was excavated for a length of 7,000 ft. and width of 500 ft. to give a water depth of 10½ ft. for preventing ice from grounding and blocking the intakes.

Water conduits

The twin conduits are about 4 miles long. They are 46 ft. wide and 66 ft. high to the crown of a three-hinged arch roof. The combined capacity of both the conduits is about 83,000 cusec. under a velocity of 14 ft. per sec. The concrete walls and the floor have a minimum thickness of 2½ ft. The arch is 5 ft. thick at the top and 6 ft. at the base (Fig. 3).

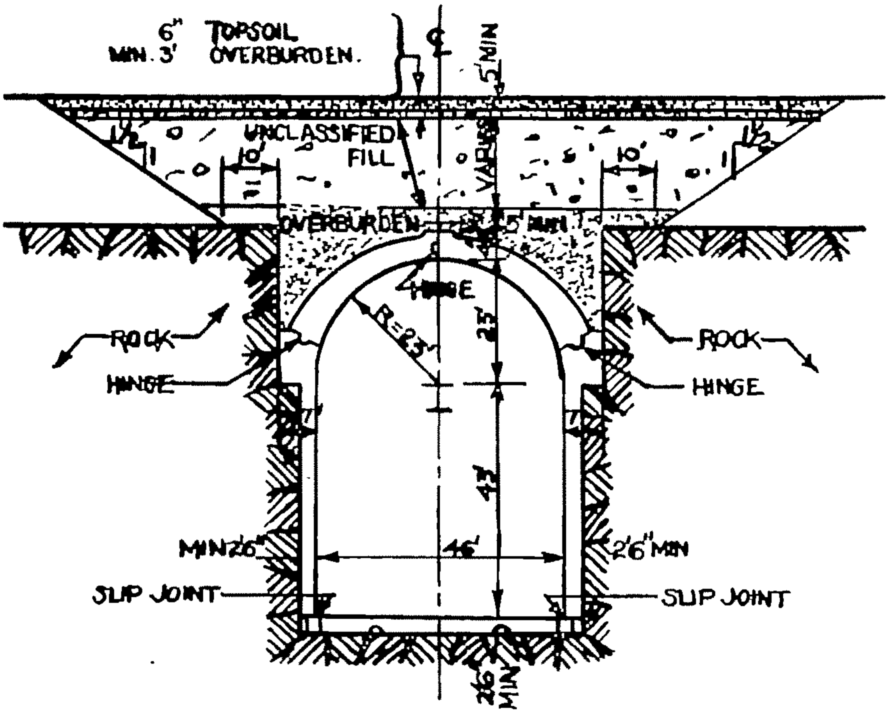


Fig. 3

Cross-section of the conduit

To construct the conduits, a trench was first excavated, which was 150 ft. deep at some places. Concrete was then placed and the trench was covered. The top of the conduit is more than 40 ft. below the ground surface. The conduit drops by 11 ft. between the upstream and downstream ends. The open canal between the conduit outlet and the forebay is 1,800 ft. long. The forebay is 500 ft. wide, about 3,000 ft. long and 110 ft. deep between the main plant and the pump-generator plant. The open canal serves as a surge basin when the main plant requires a major shutdown.

Storage reservoir

The storage reservoir is formed by constructing a dyke (Fig. 4) around the perimeter of a rock embankment with an impervious core. The dyke has an average height of 55 ft., and is 260 ft. wide at the bottom and 40 ft. at the top. The total length of the dyke is about 34,500 ft. It covers about 1,900 acres and has a storage capacity of nearly 60,000 acre-ft. The embankment is grouted to prevent excessive water seepage. Grout holes were drilled along the centre of the dyke in the foundation rock at regular intervals of 15 ft. and filled with liquid cement (cement in water) by pressure grouting. The total length of the drilled grout holes is about 30 miles.

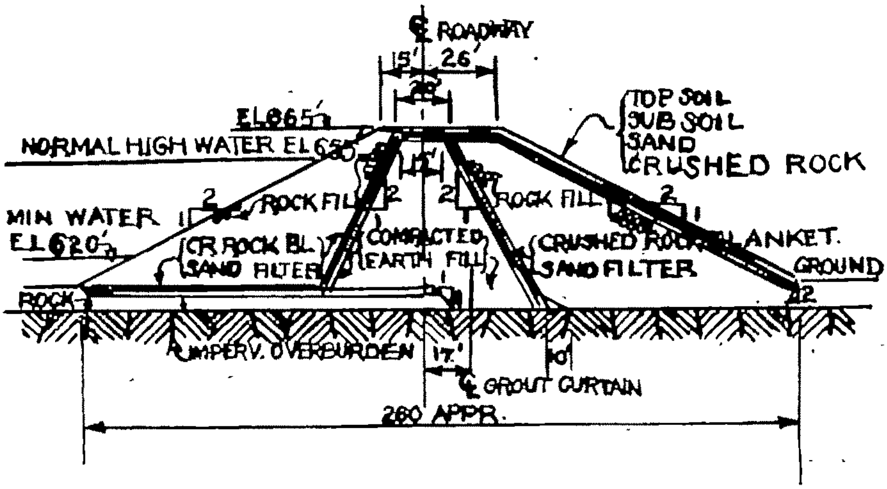


Fig. 4

A cross-section of the dyke

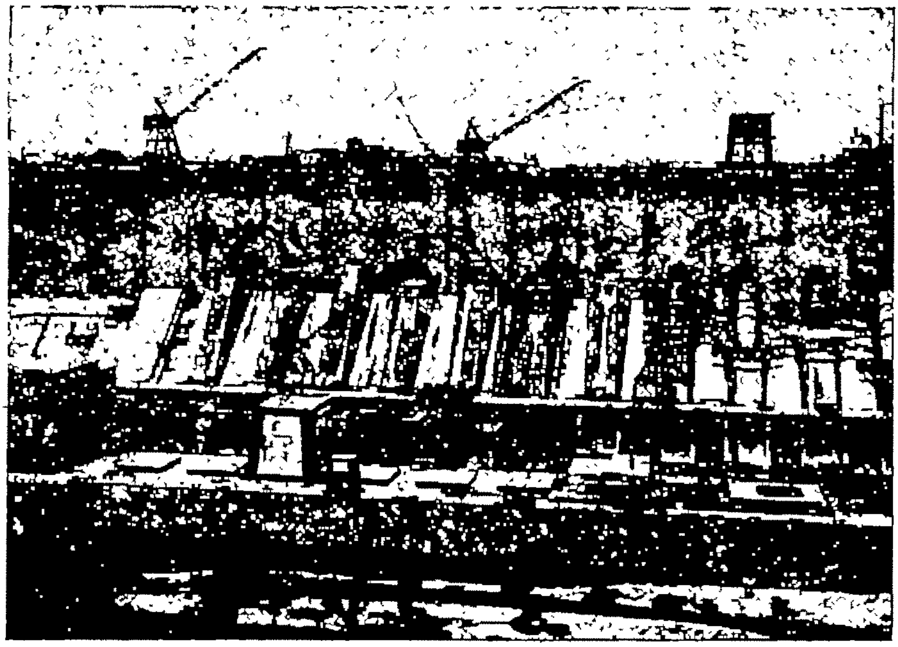


Fig. 5

A view of the Robert Moses power plant

Robert Moses power plant

The Robert Moses power plant is the main generating plant of the project and has 13 generators, each of 150 MW capacity. The plant is of semi-outdoor type. It is about 1,840 ft. long, 389 ft. high from the lowest point of the foundation to the top of the intake deck, and about 580 ft. wide from intake to final outlet.

The intake structure is about 1,100 ft. long and has 13 intake blocks with trash-racks and emergency stoplog slots. Each block is fitted with two vertical lift intake gates operated by a 90-ton travelling gantry crane.

The penstocks are of welded steel and have a nominal diameter of 24 ft. The reducing elbow near the intake blocks (upper elbow) reduces from 28½ to 24 ft., while the lower elbow reduces from 24 to 21 ft. at the scroll case extension. Each penstock is made of 52 individual rings welded together. The steel plate used for its construction varies from ¾ to 2 in. in thickness All the welded seams were tested for defects with the help of X-rays. The interior of the penstocks is painted with two coats of high zinc content paint The penstocks are encased in concrete and anchored at the two ends. A cross-section of the power plant is shown in (Fig. 6).

The generating equipment consists of 13 hydraulic turbines of Francis type, coupled directly to the generators which operate at 120 r.p.m., 3-phase, 60 cycles per sec. A 630-ton travelling crane is provided to handle the parts of the turbine and the generator assemblies. The crane is 70 ft. high and weighs more than 900 tons.

The following are some of the specifications of the equipment.

Hydraulic turbines	
Number	.. 13
Capacity	.. 200,000 h.p. at 300 ft. head
Diameter of runner	.. 17 ft. 1 in.
Diameter of head cover	.. 23 ft. 6 in.
Weight of rotating parts	.. 198 tons
Generators	
Number	.. 13
Capacity	.. 167,000 kVA/150,000 kW
Diameter of stator frame	.. 40 ft.
Diameter of rotor	.. 34 ft.
Diameter of shaft	.. 4 ft. 2 in.
Weight of rotating parts	.. 668.5 tons
Weight of stator with coils	.. 235 tons
Weight of shaft	.. 56 tons
Weight of complete generators	.. 1,115 tons
Transformers	
Capacity	.. 3-phase, 180,000 kVA

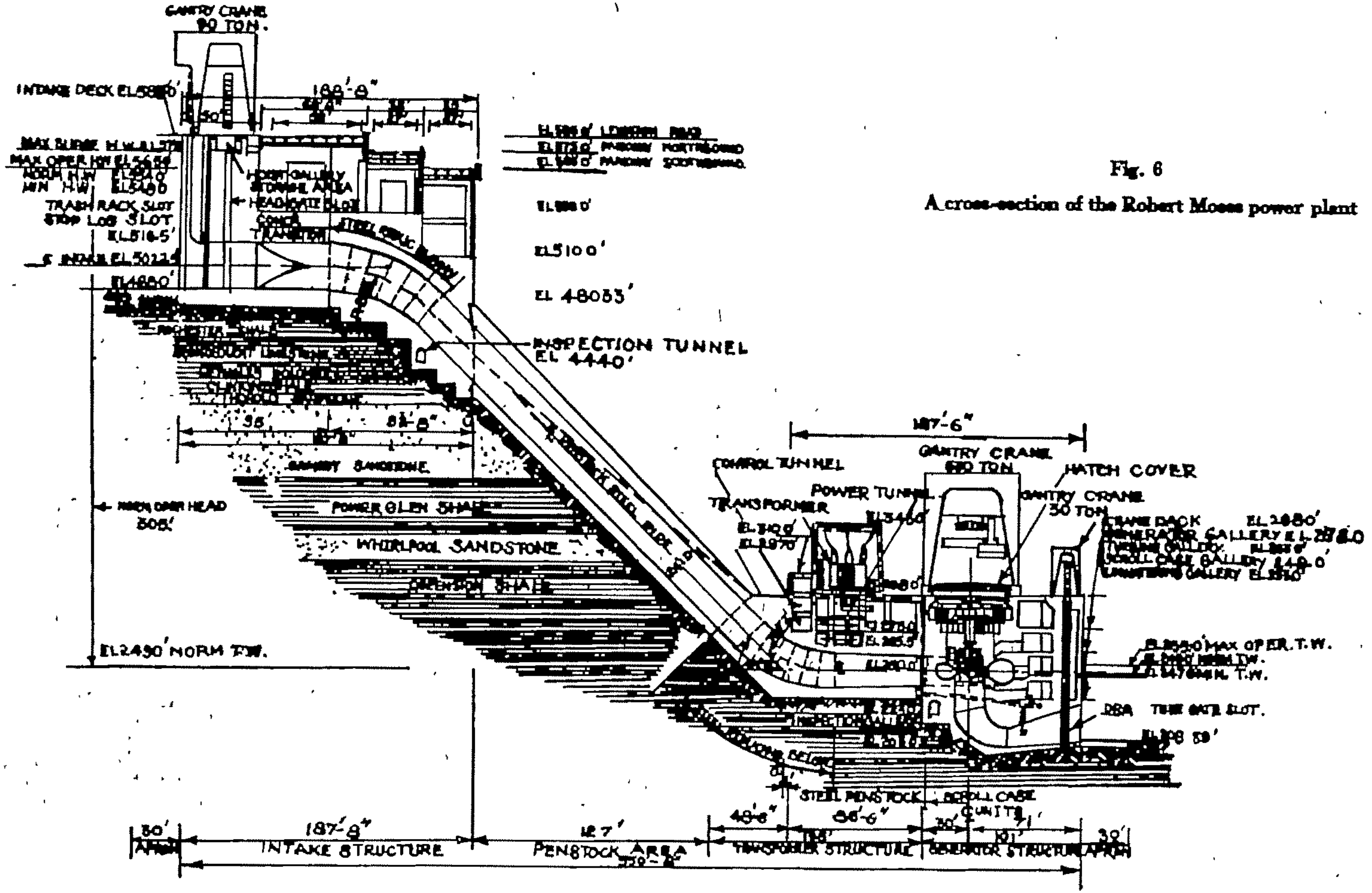


Fig. 6

A cross-section of the Robert Moses power plant

The generation is at 13.8 kV. The connection to the switchyard from the generators is through a high voltage oil filled cable housed in a reinforced concrete underground tunnel. The voltage is then stepped up to 115, 230 and 345 kV to meet various transmission requirements. The cable circuits are nearly 61,620 ft. in length and are filled with about 138,000 gallons of special insulating oil.

Lewiston pump-generator plant

The Lewiston pump-generator plant, as stated earlier, pumps water during night into the reservoir and works as a generating plant during the day. It is located about a mile upstream of the main power plant. It is 940 ft. long, 160 ft. high and 240 ft. wide. A cross-section of the plant is shown in Fig. 7. The following are some of the specifications of the equipment used in this plant (Fig. 8).

Pump-turbines	
Number	.. 12
Type	.. Modified Francis type
As a pump (each)	.. 3,400 cusec. at 85 ft. net head
As a turbine (each)	.. 28,000 h.p. at 75 ft. net head
Diameter of runner	.. 17 ft. 2 in.
Diameter of shaft	.. 2 ft.
Diameter of outer head cover	.. 18 ft. 2 in.
Total weight of rotating parts	.. 78 tons
Motor generators	
Number	.. 12
As a motor (each)	.. 25,000 kVA
Diameter of stator frame	.. 30 ft. 8 in.
Diameter of rotor	.. 24 ft. 11 in.
Diameter of generator shaft	.. 2 ft. 4 in.
Weight of rotating parts	.. 157.5 tons
Weight of assembled stator with coils	75 tons
Weight of complete unit	.. 295 tons
Penstocks	
Number	.. 12
Length	.. 92 ft.
Diameter	.. 18 to 24 ft.
Transformers	
Capacity	.. 100,000 kVA

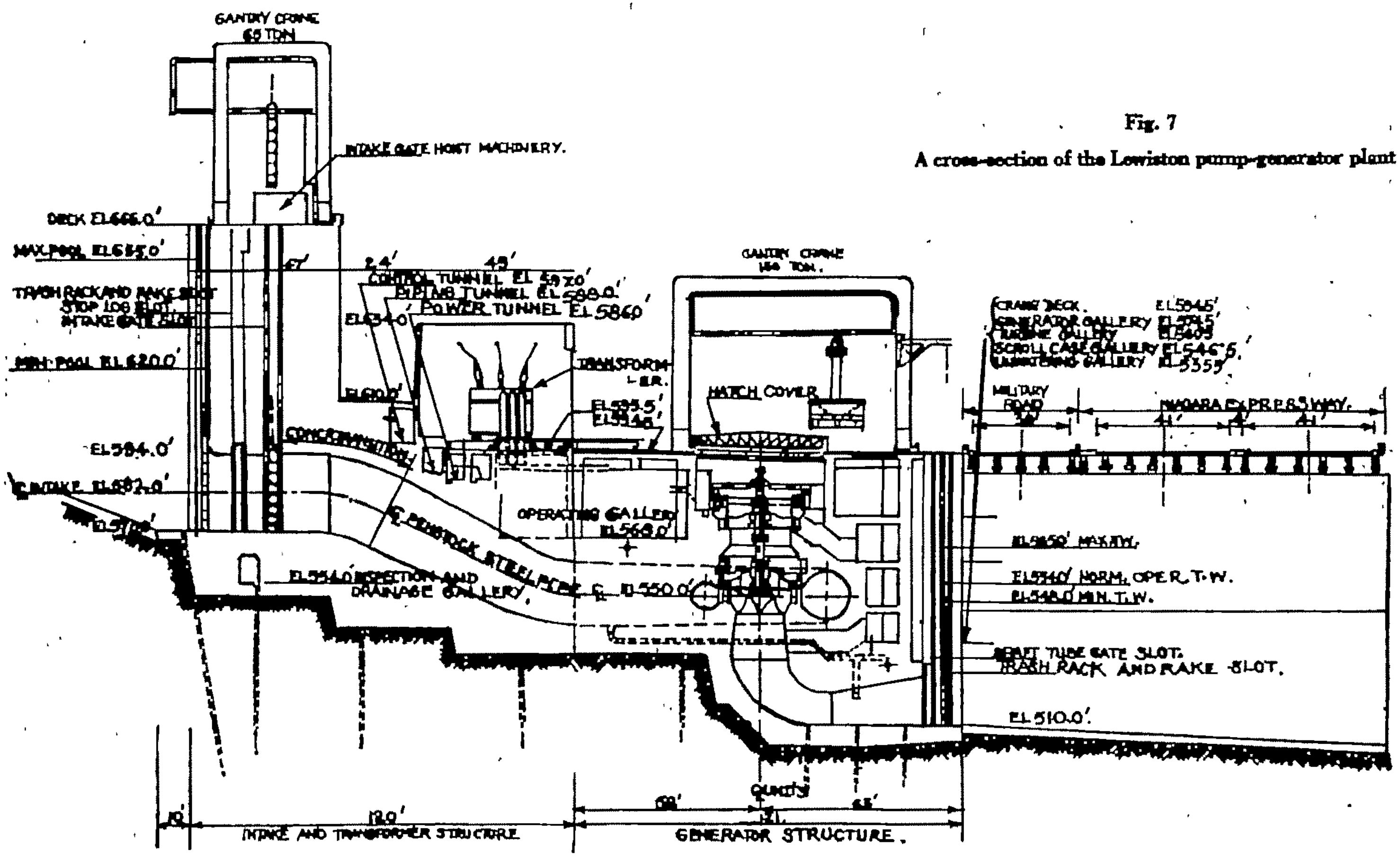


Fig. 7

A cross-section of the Lewiston pump-generator plant

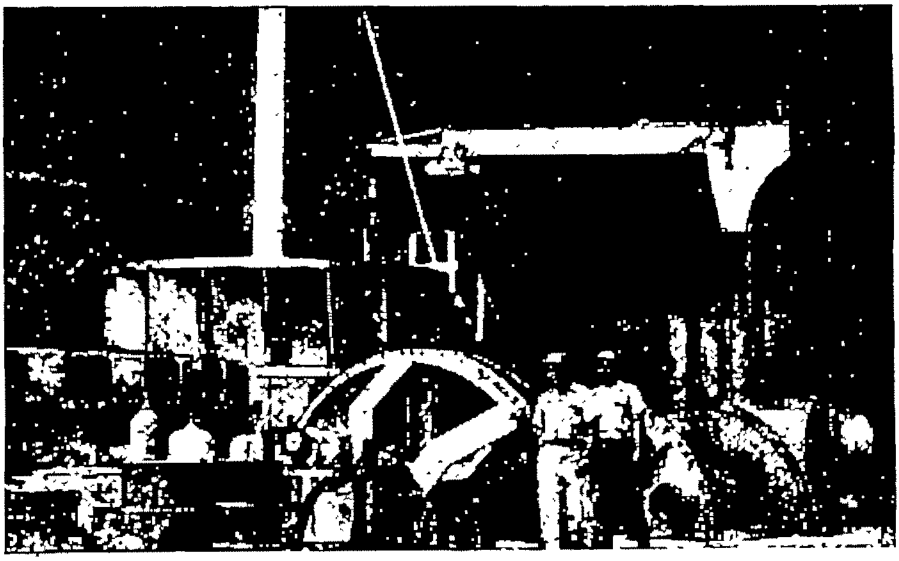


Fig. 8

Lewiston pump generating plant—a view of the runner and generator rotor

Some aspects of construction

Rock for the crushing plant comes from the excavations for open canal and conduits. The plant and the aggregate stockpile occupy about 81 acres, of which 26 acres are occupied by the settling basins holding 65,000,000 gallons of water. After washing the aggregate, the water is returned to the settling basins to allow its load of dust to settle down and the same water is used once again for washing.

There are two primary crushers, each capable of reducing boulders up to 5 ft. in diameter to 6 in. in size at the rate of 1,000 tons per hr. From the primary crushers, the rock moves on a 2-mile system of 42 in. and 30 in. conveyer belts through secondary and tertiary crushers, stockpiles, sand mills, etc., and is finally loaded into the shipping bins. The gradings of crushed rock produced are 6 in., 3 in., 1½ in., ¾ in., and sand. During the peak of construction activities, six concrete batch and mixing plants were operating 24 hr. a day for six days in a week.

Each mixing plant is completely automatic with graphite recorders for recording the proportion of aggregate, cement and water. Each plant receives aggregate from the crushing plant. Coarse aggregate is rinsed and screened before use. Cement is delivered by cement screws or by air pumping.

Temperature control of concrete has been given particular importance. To produce cool concrete in summer, each mixing plant was equipped with refrigeration equipment. Ice and chilled water or chilled water and chilled coarse aggregate were used during the hot weather. During the summer of 1960, more than 600 lb. of ice were used per min., and during winter, hot water and warm aggregate were used. Calcium chloride was also used at the rate of 1% of the weight of cement to increase the rate of strength development. All these factors reduced the period of time required for the protection of fresh concrete from the effects of freezing.

Natural cement has been used with Portland cement in the ratio 1 to 7 to reduce the potential heat of hydration of the cement. Natural cement gains strength slowly over a longer period. This permits the dissipation of heat generated by the cement over a longer time and thus prevents excessive temperature buildup. Air entrainment was used in all concrete to resist the effects of freezing and thawing, and to improve the workability of the mass concrete.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Andhra Pradesh Centre

Chairman's address by Shri A. Ramamurthy, B.A., B.E., M.I.E., at the 24th Annual General Meeting of the Centre on December 16, 1961

The Chairman welcomed the Chief Guest, Dr. M. S. Thacker, Secretary, Ministry of Scientific and Industrial Research, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

Delivering his address, Shri Ramamurthy said, 'It is the usual custom for the elected Chairman to give an address on a subject he deals with. While considering the subject, I remembered the slogan which every visitor to London after the Second World War would have seen, 'Produce or perish'. The British had to pay heavily in the war and their existence depended only on their exports. The major portion of their industrial production was earmarked for export by the Government. To use their own products, they had to produce more; and to stabilize their national economy, they had to export more. They had no other alternative than to put their entire energies into one factor, to produce as much as possible for export and also for their needs.

India needs a similar intensive programme of production, but for a different cause. The population is increasing at a fast rate, and the needs of the common man are also increasing. The declaration of the country as a welfare State by the Constitution has created obligations on the State and every citizen. It is clearly laid down in the Constitution:

> 'That the citizens......have a right to an adequate means of livelihood...... that the operation of an economic system does not result in the concentration of wealth and means of production to the detriment......The State shall make provision for securing just and humane conditions of work and for material relief......The State shall endeavour......to all workers, agricultural, industrial or otherwise, work, a living wage, conditions of work, ensuring

a decent standard of life and full enjoyment of leisure and social and cultural opportunities.'

It is to this end that we have to work and this would lead to a new slogan, 'produce and prosper'.

The object of all industries, whether in the field of agriculture or inside a factory, is to produce as much of a marketable commodity as possible at the lowest cost. During the industrial revolution in Britain, the industrial production increased by leaps and bounds consequent to the new power units that were made available. Since then, other countries have also developed their industries and the world market has become competitive. As each country advanced, the need for more efficient working became imperative and production methods had to undergo radical changes. Countries like the U.S.A. started adopting methods of mass production to cut down costs, and new tools and processes came into being.

India is ambitious to enter into the field of large scale industrialization. We were lagging behind in industrial advancement, but now we are forging ahead with speed. The need for maximum utilization of materials, machines and men is felt in the country. We have to use more in digenous materials and import less from abroad, as it will involve considerable foreign exchange. We have limited supply of machinery. We are faced with shortage of technical personnel, and we have to train a large number of workers in skilled jobs. The need for higher productivity is unquestionable and demands the attention of every engineer in the country.

The Planning Commission have not been unaware of this, as is clear from the final draft of the Third Plan wherein it is stated, 'The rate at which the average levels of productivity rise in different sectors is a true measure of the pace and quality of the advance achieved......The only enduring basis for the strength and dynamism of the economy is a rising level of productivity'.

The planning of industries in public or private sector has not been without results. The results show that we are moving in the right direction, as the following table will indicate :

Item	1950-51 (millions of rupees)	1955-56 (millions of rupees)	1960-61 (millions of rupees)
National income	91,100	1,08,000	1,34,800
Net investments	4,480	7,900	14,400
Net domestic savings	4,550	7,560	13,100
Consumption expenditure	86,550	1,00,440	1,21,700

There may be small errors in the above figures, but basically, they reflect the progress achieved.

An expert of the Technical Cooperation Mission from the U.S.A. has analyzed the causes that are responsible for low productivity in our country and they are : (i) excessive wastage of materials and loss of large amount of scrap. The knowhow of manufacture for better utilization of materials and better methods of salvage should be looked into. Often, improper quality control results in considerable waste, as faults may be located after the product is finished and salvage may then be impossible. Wastage of materials is also due to improper methods of handling ; (ii) inventories are very high. There is a larger sinking of capital than is really necessary. Unused stores divert the required capital for working, thus putting a heavy strain on the industry ; (iii) poor production, planning and control resulting in avoidable delays and emergencies, and unnecessary overloading or underloading of plant and equipment. This increases labour costs and causes failure in time schedules. These problems are faced by practically all industries, and proper production planning and control go a long way in solving them ; (iv) inadequate instructions and improper training of workers, which results in inefficient and incorrect methods of working ; (v) excessive overhead costs ; (vi) and high repair and maintenance costs. There are a large number of breakdowns or failures of machinery, the causes for which are many, but improper utilization and lack of care are the most serious. The worker must be educated to use the machines properly.

While considering the problems of productivity, mention is made of maximum utilization of the resources of materials, machines and men. Every engineer is conscious of this, and if full utilization is not made, it is generally due to lack of thorough knowledge of industrial engineering or ability to do so due to extraneous causes. In over 20 years of factory inspection in the State, it has been my experience that the engineer is likely to forget the most important resource, the men. Though it is generally accepted and even argued that the men should not be forgotten, in the anxiety to produce more, they are neglected.

The country is short of trained technical personnel. These men, apart from being difficult to get, are vulnerable. The loss of a technical man cannot be easily replenished. The industry has to work under many hazards and accidents may cause irreparable injuries to men and loss in the production programme. It has even been remarked by the Chief Inspector of Factories, Great Britain, a century after the Factory Act came into force, that shafts revolve and belts move on the pulleys without guards, and the engineers start their factories under such conditions in their anxiety to start production as early as possible. The main problem with regard to accidents is not what to do after an accident occurs, but to prevent the incidence of an accident that is likely to injure the worker. An analysis of accidents that occur generally has shown that over 88% of them can be averted.

Mechanical guarding and prevention of mechanical and physical hazards are the fundamental requisites of a safety programme. A detailed analysis shows that much has yet to be done to prevent accidents which result in wastage and non-utilization of men in industry.

Accident prevention is a science which deals with facts and natural phenomena. The problems of accident prevention can be solved by careful analysis of the factors involved. The anatomy of a number of accidents has indicated five such factors : (i) the environment, (ii) the fault of a person, (iii) the unsafe act done, including the existence of a mechanical or physical hazard, (iv) the occurrence of the accident itself, and (v) the injury.

The first requisite for prevention of accidents is the training of workers and the provision of an environment congenial to work. It is accepted that safe environmental conditions give higher productivity with the same machines and materials. If mechanical hazards are eliminated by proper guarding of machines, and unsafe acts of workers are prevented by regular training in safer methods of production, there will be no accidents. It has also been noted in the analysis of specific groups of accidents that a large number of them do not cause injury. The Factory Act defines an accident as one in which a worker is disabled as a consequence of an injury for a period of 48 hr. or more. Such unreported accidents are large in number, perhaps many times more than accidents causing injury. But accidents which do not cause an injury are more important. Consider, for instance, a weight dropping within a few feet of a worker. If it had fallen on him, he would perhaps have suffered a grievous injury. The fact that it fell away from him goes unnoticed and no investigation is made. Such cases should be investigated as much as an accident which results in injury to a worker, The industrial engineer or safety officer should take more cognizance of such possible accidents and ascertain that methods for their prevention are immediately adopted.

I would like to state the work done in Andhra Pradesh in reducing the occurrence of accidents. An intensive programme for greater safety of industrial workers has been undertaken since 1956, in which year there were 4,079 accidents, of which 24 were fatal. In 1957, the number of accidents reduced to 3,816, of which 19 were fatal, and by 1959, the number was 3,504.

In the words of the Chairman of the National Productivity Council, 'No social system can work without the willing cooperation of the working class', and unless the Government, the employers and the labour unreservedly accept the need for such cooperative effort, no social legislation can succeed. This was clearly demonstrated in the rice mill industry in the State. A large number of workers are employed in rice mills in the State, nearly 16,000 of them being in the registered factories alone. There are also a large number of small units which are not registered, and, are therefore, out of the purview of the Factory Act. It was found that after many years of inspection nothing could be achieved by legal means. The employers in every district were, therefore, approached to assist and cooperate in this work. A programme was laid for each district to undertake the work of guarding of machinery. The employers formed associations which undertook to ensure that every factory would provide the protective fencing for its machinery. They formed voluntary committees to conduct a competition on this work. The workers were also enthusiastic. The leading worker of each factory was assigned the task of advising the management with regard to the measures to ensure safety. The employers were willing to spend the money involved in this work. The result was that when these competitions were over, most of the moving machinery in this industry were well guarded, and most of the workers had realized the dangers they were facing without such fencing. It can now be safely said that accidents in rice mill industry have considerably reduced in number. Similar safety programmes are being adopted by other industries such as oil mills, printing presses, sugar factories, etc.

But this is not all. There is necessity to teach the workers that the machinery should not only be guarded, but should be fully utilized. A well guarded machine is safe and therefore a good tool for increased production. With the same materials, men and machines, more goods of better quality can be produced.

I think, it was Alfred Marshall, a famous British economist, who said that the British Factory legislation was a disgrace to British industry. What he meant was that the employers and the workers should themselves improve the conditions so as to make the existence of such a legislation superfluous. Another aspect which is recognized but is not receiving full attention is the need for research in industry. If we want to produce new products or improve the quantity and quality of the existing products with the same available resources, research is essential. While this fact is acknowledged, it is surprising that in Andhra Pradesh there is no private sector industry which is giving real attention to this aspect. It has been said that in the American industry, if solution to one problem in a hundred reaches the manufacturer, it pays for all the research done on the hundred problems and gives good dividends. Research need not necessarily be fundamental in character. It can be in the nature of re-examination by a specialist in the manufacturing processes or a re-alignment of machines for better production,or it may be readjustment of personnel. Introspection in industry is an essential feature. In short, research enables higher productivity and gives good dividends while increasing the wage earning capacity of the workers.

I have tried to focus attention on the important aspects in industry that require immediate attention. It must be remembered that it is only at the level of the individual of a firm or an organization, whether small or big, that improvements in productivity can really take place. A national programme can assist in focussing the attention of the industry on certain concepts and techniques. The actual increase in productivity depends on the individuals, whether they are directors, managers, technicians or workers. It is up to the particular industry to consider that waste of materials is a national waste, and that improper use of its personnel is a loss to the nation. It is the duty of every engineer, whether he is engaged in construction, factory or agriculture, to understand that higher productivity is the essential need of the country today, the industry produces for the benefit of man, and mutilated workers should not be the byproduct of the industry.'

Madras Centre

Chairman's address by Shri O. T. Raghavan, B.A., B.E., M.I.E., at the 39th Annual General Meeting of the Centre on December 29, 1961

The Chairman welcomed the Chief Guest, Shri S. Ramchandra Iyer, Chief Justice, Madras, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

Delivering his address, Shri Raghavan said, 'Sanitary engineering as understood some years ago consisted of study and practice of water supply and drainage, commencing from the sources of water supply, and ending with the disposal of sewage. The science of environmental hygiene developed later, and has gained much importance only recently with the study of the preventive aspects of public health. All advanced countries have gone through the process of urbanization when the population started moving into cities and towns. Combined with industrialization, the necessity for safeguarding the health of a concentrated population through protective measures was felt, and the science of environmental sanitation and hygiene came into prominence.

The water supply system of Madras provides water for a population of 1,800,000. The area of the city is about 50 sq. miles. The source of water supply is the River Kortalayar, a small river which is entirely dependant on the north-east monsoon whose vagaries are many ; in recent years, there have been consecutive partial failures of the monsoon and the city's water supply depends on this rainfall.

The average daily supply of water in the city is only about 18 gallons per head, which is very low in comparison with other cities. It should be much more for domestic needs and industrial purposes. A supply of about 50 to 75 gallons per head is desirable. Based on a supply of 40 gallons per head, the total requirement for the coming two decades will be 80 to 90 million gallon per day, as against the existing 32 to 33 million gallons per day.

Many rivers in India overflow their banks during heavy floods and cause considerable damage to life and property. We have read about the violence of flood waters of the Gomathi, the Jumna, the Cauvery, etc., and much could not be done for flood prevention or against its recurrence. It is the same water that is scarce in the deserts of Rajasthan and in several cities, towns and villages in other parts of our country during certain seasons. An interlinking of rivers, at least in a zonal manner, appears to be a necessity not only for the prevention of floods, but for irrigation and water supply also.

The perennial rivers in north India are being interlinked, and once the projects are completed, by spreading out the usefulness of the available quantity of water through a wide range of canal systems meant primarily for irrigation, water supply to large number of towns and villages in those areas can be developed without much additional cost. The quantity of water needed for drinking is very small as compared with irrigation requirements.

The most important river in south India is the Cauvery and its waters have been almost fully utilized. Realizing the danger to the city due to the increasing population and the static, though not dwindling, resources of water supply, the Government have ordered an investigation into the possibility of pumping water from a convenient point on this river. It is understood that the scheme has been found feasible with a concrete pipeline and three or four stages of pumping. This scheme can also provide drinking water to small towns and *panchayats* en route. It has been estimated that this scheme will bring additional 40,000,000 gallons of water to the city of Madras. Thus, it will more than double the present daily supply from the existing sources. Since the population is increasing at a rapid rate, the plan contemplated will only just meet the requirements of an anticipated population during the next one or two decades. For later years, either the pipeline can be duplicated or water from the northern river systems can be obtained. It may be expected that by that time the interlinking of the major rivers to the north of Madras take place the surplus waters of the rivers in the neighbouring States will be allowed to irrigate land in the south.

The first stage of the Cauvery scheme is expected to cost about Rs. 20 crores. This is a large amount, but considering how precariously we have to depend for water on the monsoon, and the fact that the Madras city's water supply neither meets the minimum domestic requirements nor the needs of vital industries, the provision of a perennial supply has become a 'must'.

Sometime ago, Dr. K. L. Rao, Past-President of the Institution, stated that the water supply problem of cities like Madras and Bangalore should be solved on the basis of what was done under similar circumstances in the important cities of the world. In Birmingham, water is brought from a distance of 73 miles in conduits and pipelines, siphoning below small rivers and streams. Cities and areas within the metropolitan water district of Southern California in the U.S.A. get their water supply through an aqueduct with a capacity of 1,000,000 gallons of water per day, obtained by pumping through a height of 1,617 ft. over mountain barriers.

The main problem facing the city's water supply is the augmentation of its source. Tapping a perennial source is the only permanent solution to this question, but the Corporation's attention is very often drawn to two other possibilities as supplementary propositions, *viz.*, tapping subsoil water and conversion of sea water. The Ground Water Exploration Section of the Geological Survey of India carried out a few investigations including five exploratory boreholes in the Ponneri-Minjur area, about 18 miles to the north of the city, which revealed the presence of good water bearing sands within a depth of 170 ft. below ground level. The result suggested the possibility of developing a reasonable source from this and from an adjoining area upstream of the Kortalayar River. Rough esitimates were prepared by the Corporation for the pumping and conveyance of about 3,000,000 gallons of water, but considering the cost involved and the fact that this water source when developed can be more economically utilized for the fast developing Thiruvottiyur area, the proposal was not taken up for immediate consideration.

All countries in the world depend on rainfall, their cultivation and industries depending mainly upon the amount and rate of precipitation. The problem everywhere is how to get more water. Hydrology is studied in combination with research in physics, chemistry, biology and other allied sciences for making better use of the water resources. As a result, desalting of sea water, rain making by seeding of clouds, and the use of nuclear energy for purification and reuse of waste waters have been taken up, but they are yet in the initial stages of development. Multipurpose installations can produce fresh water from sea or brakish waters, and also generate power as a byproduct. Coal, oil or electricity can be used in the process, but the production cost varies according to the type of energy used. Nuclear power can provide a solution to this problem of cost as its potentialities are enormous. Research in this field is advancing rapidly and it is hoped that it will soon be possible to produce potable water from sea water at reasonable cost.

There are two known methods of purifying saline water : (i) by distillation or freezing, and (ii) by the 'membrane' process or 'electrodialysis'. The first process comprises evaporation and condensation of water vapour. This is a costly process involving large quantities of thermal energy from some form of fuel. An attempt is therefore made to bring about the maximum evaporation with the least amount of heat by employing a multistage process which utilizes latent heat of steam in the first stage evaporator to heat the water in the second stage.

Two plants in Kuwait are producing 5,000,000 gallons of water per day ; and one in Aruba, Dutch West Indies, produces 2,700,000 gallons per day. At Free Port, Texas, a demonstration plant is being built by the United States Government for purifying 1,000,000 gallons of water per day.

Solar heat can also be used for distillation, but it involves large shallow plastic lined basins where the sun's heat can warm the water and slowly convert it into vapour which can then be condensed and collected. Though, in desert areas, sunlight is available in plenty, the installation becomes vast and expensive.

In the freezing process where less energy is required than in the distillation process, ice crystals are separated and melted into fresh water. The membrane process, which is more suitable for brakish water than for sea water, involves the separation of the sodium and chlorine ions in a salt solution by means of negatively and positively charged membranes.

Mr. L. B. Johnson, Vice-President of the United States, in the course of a discussion on desalinization of water, said that the countries desperately in need of fresh water would welcome a saline water conversion pilot plant, and with the advice of their Office of Saline Waters, they could build such plants under their foreign aid programmes.

Before saline water conversion comes within our reach, conservation of the existing sources of supply should be contemplated. In tropical countries, evaporation and precolation remove more than 6 ft. depth of water in a year, and in shallow lakes with a large waterspread, this loss is considerably heavy. A liquid chemical, cetyl alcohol, has the property of spreading over the surface of water in a thin layer, thus sealing off contact with air and retarding evaporation. Cetyl alcohol is used in medical and cosmetic preparations. Its properties are stated to be harmless if used in reservoirs meant for domestic water supplies. The Irrigation Branch of the Public Works Department, Madras, is carrying out a series of experiments with cetyl alcohol in some irrigation tanks near Madras. If the results turn out to be satisfactory, it is hoped that considerable quantity of water will be saved from such losses in the reservoirs at the Red Hills and Poondi.

As we advance in our public health endeavours, a serious problem is slowly and steadily mounting before us. It is a problem which we are creating by our inadvertent actions and ignorance of its serious consequences. It is the pollution of water sources which is fast reaching a stage where a determined check is imperative and control by legislation is called for. It is gratifying to note that committees are being set up both at the Centre and State levels for studying the problem and suggesting preventive and remedial measures.

As a result of the Five Year Plans, industries are growing rapidly, particularly in and around large cities and towns. Industrial wastes thrown into the nearest waterways are constituting considerable hazard to drinking water supplies. The consumers are ignorant of the dangers involved. Cities and towns that draw their water supplies directly from rivers should therefore be warned of the possible dangers.

In the U.S.A., the pollution of water has reached serious proportions. Mr. Kennedy is reported to have said, 'The pollution of our water has reached the proportion of a national disgrace. It endangers our health. It limits our business opportunities. It destroys creation...... In many areas of the country, we need new sources of supply—but in all areas we must protect the supplies we have'. He has thus proposed a more effective water pollution control programme. These facts must be an eye-opener to developing countries like India which are now in a position to profit from the experience of the developed countries. Increasing population and rapidly rising standards of living will increase the demand for wholesome water supplies, and this will result in search for surface water for drinking purposes. The attention of water resources engineers has therefore to be drawn to water quality through pollution control.

The problem of maintaining the quality of the city's water supply has been the story of an endless war waged against raw water which could not be successfully treated by slow sand filtration. Since the inception of these filters in 1914, the results have been bad. Though, after prolonged experimentation, it was discovered that this water can be successfully filtered only after chemical coagulation and settlement, much could not be done due to lack of finance. A pilot plant of 10 million gallons per day capacity has been constructed in our water works. Based on the satisfactory results obtained from this plant, the Government have now approved the Corporation's recommendation to put up an additional plant of 30 million gallons per day capacity.

The question which is now being discussed is 'can urban water supply and sewerage schemes be made self supporting? Let us first consider the question whether water supply for a city like Madras can or should be made a self-supporting or a profit-earning concern. When an irrigation or an electricity project is envisaged, the fact that it benefits the population of a district or area qualifies the scheme for being recommended as a State undertaking, and finances for its implementation are then obtained from the State or the Centre. The revenue realized from the beneficiaries is able to pay back the investment. On similar lines, in a water supply or sewerage scheme for a city or town, the benefits go only to the local population and the financial burden will therefore fall on them. Will it be possible to tax this small section of population to the extent required for paying up the debt charges, interest on loans, maintenance costs and also earn a profit? It should be remembered that the high standard of services being maintained in a metropolitan city like Madras is not entirely for the city's tax paying public. Madras is the capital of the State; it is the centre for all the commerce and trade of the State; its port, harbour and railways maintain the State's incoming and outgoing trade; it is the seat of the Government; it is also the venue of conferences—political, commercial, technical and cultural—and industrial and agricultural exhibitions. Such a city should be provided with the best services such as water supply, drainage, communication and street lighting, and this is the responsibility of its municipal administration. Can all amenities of such high order be provided from the revenue derived from its tax paying public? The tax structure of the Corporation shows that the main part of it is derived from property tax, and its budget of expenditure shows what large slices of this revenue are going away as repayment of loans and interest charges. The incoming revenue is insufficient to meet the growing demands. The State Government has, therefore, sanctioned grants and loans for all the new works for the improvement of water supply and drainage. However, this pattern of assistance will soon become inadequate when works of large magnitude such as the augmentation of city's water sources are undertaken.

If, however, a Metropolitan Water Board, is conceived for Madras, it can take the functions covering not only the role of financiers but also of planning, executing and maintaining the works as business ventures. It can exercise its statutory powers for the provision and maintenance of these amenities. If adequate supply of water can be assured to the citizens, collection of revenue from the beneficiaries, particularly the progressive industries, can be obtained without any reservation, thus facilitating easy repayment of capital investments. The Board can carry out investigations, prepare plans and estimates, execute water supply schemes, and also maintain water supply schemes, if required.

If Madras finds its perennial supply from the Cauvery, the project can provide drinking water to many small towns and *panchayats* on the 150-mile route of the pumping main which will be an *aurora australis* for Madras. All these towns and villages, and also those in the immediate vicinity of the city, can be brought under the Board.

The Board's work will not be easy considering the large amount of money it has to find for launching a programme of work which should ultimately make it self-supporting, if not a profit earning concern. The Board, in its initial stages of organization, will have to depend on the State Government for funds, later developing into a financially autonomous body, its borrowing capacity being fixed by the Government every year. The loans within this sanctioned capacity will be raised by the Board in the open market or as private loans. With such capital and financial assistance from time to time from the Government in the form of advances, remarkable progress can be made.

Though the Corporation has always advocated for more munificent assistance from the Government by way of free grants for the development of the city's water supply in view of its slender financial resources, the day is not far when the Corporation or the Metropolitan Water Board, if formed, will have to balance its water supply expenditure with its water supply receipts and also pay up the annuity taken on executing capital schemes.

On a national level, lack of adequate protected water supply and sanitation facilities are responsible for the high incidence of water and filth borne diseases. Periodic epidemics take a heavy toll of life and lower the vitality of the people.

About one-sixth of the country's population lives in urban areas, it is estimated that about 50% of the urban areas lack protected water supply and 85% the amenity of a sewerage system. It has been estimated by the Committee on Plan Projects that about Rs. 900 crores have to be spent on such schemes including additions and improvements to some of the existing systems. Even at the rate of about Rs. 100 crores in each Plan, it will take nearly 50 years for all the urban population to get these facilities. If the increase in population during this period is also taken into consideration, it will take more time. The needs of the rural population in this regard are estimated to cost Rs. 300 crores. If, as the Third Public Health Engineers' Conference has suggested, the urban schemes are to be completed in 25 years and the rural schemes in 15 years, the annual outlay will be about Rs. 36 crores on urban and Rs. 20 crores on rural programmes. This will impose heavy financial burden on the country. We will, therefore, have to wait longer.

Whatever the rate of accomplishment, there is no doubt that for efficient and economic planning, design and execution of water supply and sanitation schemes, specially trained and qualified public health engineering personnel are necessary. Training of civil engineers who are called upon to take up design and execution of public health engineering works should receive adequate attention. As many engineers as possible should be sent for post-graduate studies and short term courses in public health engineering.

With regard to the machinery and equipment needed for water supply and sanitation projects, Indian manufacturing firms are coming forward with goods of high quality, but the supply is not able to meet the demand. Manufacture of higher capacity pumps and motors, water meters and other components such as cast iron pipes will have to be stepped up.

For post-graduate studies, only talented young men should be selected who will become an asset to the respective departments in course of time. They will be the best suited to handle research work, but they should be paid suitable allowances to encourage them in their work. Here I must make a mention of the Central Public Health Engineering Research Institute at Nagpur which has under its scope treatment of water, sewage and industrial wastes, environmental and industrial hygiene, radiological health, study of materials used for public health engineering works, etc., It is proposed to carry out the work of the Institute through a chain of field centers where a closer examination of the local problems at site is needed.

Though water supply and sanitation are meant for the improvement of the living conditions of a community, civic consciousness is also essential to enjoy the full benefits of such amenities. Here health education plays an important part, as it imparts that scientific knowledge which has the potential power of preventing disease and ensuring health.

I have tried to bring out the necessity for sanitation and adequate quantity of drinking water for a good community life and healthy living. Many services are required to improve the living conditions of the common man, but before poverty can be abolished, much can be done to reduce sickness and death from preventable diseases. Let me now conclude with the hope that the day is not far when water supply to our cities, towns and villages will be taken up as a national problem and all the water resources will be explored and copious quantities supplied to every one.'

Summaries of Papers Published in the Journal, vol. 42, no. 8, pts. EL 4 & GE 2, April 1962

ELECTRICAL ENGINEERING DIVISION

A Multipurpose Meter Using Bridge Rectifier

D. P. Chakrabarty
Associate Member

This paper discusses the design of a multipurpose instrument for the measurement of current, voltage, power and power factor by the use of a bridge rectifier circuit in conjunction with a vacuum tube metering arrangement. The instrument has two components : (i) for power and power factor measurement by means of the bridge rectifier circuit ; and (ii) a vacuum tube voltmeter to enhance at the output of the first stage the utility of the instrument. Amplification of the vacuum tube voltmeter, it is found, increases the sensitivity of the instrument when used as a wattmeter or a power factor meter. Also, with proper switching circuits, the instrument can be used for the measurement of direct and alternating currents and voltages. Thus, the instrument serves as a multi-purpose meter, the chief advantages being that, when used as a wattmeter, its power consumption is lower, and frequency characteristics better as compared with the conventional wattmeter.

Possible Criteria for Determining the Condition of Lighting Arresters

V. Prabhashankar
Non-member
S. S. Hubli
Non-member
and
D. J. Badkas
Associate Member

In this paper, it is shown that the non-linear resistance elements of silicon carbide in a valve type arrester deteriorate with the conduction of surge currents. The D.C. voltage necessary to drive a specified current of the order of 10 to 100 mA through the non-linear resistance element after the passage of impulse currents is found to change with the number of impulses passed through the element. This fact may be used as a criterion to determine the condition of arresters on site. Instruments are described which can locate damaged arresters and the paisage of lighting surges, and permit measurement of the arresters condition.

Some Aspects of Electrical Development in Andhra Pradesh

B. P. Sastry
Associate Member

The integrated development of water and land resources is vital to the economy of a country, and the per capita consumption of electricity has come to be universally regarded as an index of economic development. Andhra Pradesh is the fourth largest State in India and the third in population. It is endowed with considerable mineral resources and two large rivers, the Godavari and the Krishna. The estimated hydro power potential of the State is about 3,000,000 kW, and the State possesses all the prerequisites for large scale industrialization. This paper deals with some of the aspects of electrical development in Andhra Pradesh.

Power Development in Burma—Technique of One-Day Lighting Schemes

M. Subramaniam
Member

Burma abounds in mountains, rivers and hydro-electric resources, estimated at 3,000,000 kW. The Second World War ravaged the country, seriously impeding its development schemes on all fronts. With the work of rehabilitation started in 1955, Burma has now over 530 centres with electrical facilities with an installed capacity of 168,000 kW, as a result of the efforts put in small communities with purpose and determination in the achievement of a new technique called 'one-day lighting schemes,' which made it possible to electrify the whole of a village or part of a town in one day. The paper describes how this work was done.

Development of A.C. Electric Traction at Industrial Frequency

S. P. Tonse
Non-member

Of all the forms of motive power so far applied to rail track, electricity seems to hold the greatest promise. Phenomenal world speed records on rail routes have been established in France by electric locomotives. In view of the need to conserve coal and reduce the import of Diesel oil which is a perennial drain on the country's foreign exchange, thus paving the way for full utilization of the large in reserve, *viz.*, the hydro potential that can still be harnessed and the atomic power resources that are being planned, electrification requires no justification, particularly in the context of the many amenities it provides. This naturally leads us to the problem of large scale electrification of our railways.

A comparative study of the merits and costs of various electric traction systems now available will indicate that under the prevailing conditions in India 25 kV, 50 cycles A.C. system proves to be of particular interest, especially in increasing the throughput of single and double line sections which are nearing the limit of saturation with steam traction. This system has great technical potentialities, as it leaves the way open for the adoption of a variety of methods for transforming electric power drawn from a high voltage catenary in an economical manner. Explaining the technical features of the various systems, the paper discusses in detail the 25 kV A.C. system, indicating the electrification schemes on hand and the future policy to be followed in respect of transport, the key to economic prosperity of the country.

GENERAL ENGINEERING DIVISION

Noise and Industrial Efficiency—2 : Noise and Performance

H. C. Ganguli

Non-member

The maximum efficiency of an industrial worker depends on many factors which may be grouped as personal, work and environmental. Among these, the environmental factors mostly relate to the problems of lighting, ventilation, noise, humidity, etc. The problem of noise is lacking in the knowledge of its well defined effects, still a subject of controversy. The effect of noise on job performance varies according to the nature of the job. The ill-effects of noise which come in the way of efficient performance are nervous or mental fatigue and mental illness, which are found to reduce a worker's output by as much as 25%. The paper discusses the several aspects of noise on industrial efficiency. Recent studies under fairly controlled conditions have served to throw a new perspective on the problem of noise.

Use of Time-Span Instrument in Job Analysis and Measurement of Responsibility

Prof. R. Misra

Member

and

R. Banerjee

Non-member

A part of a report on a recent case study carried out in a light engineering industry, this paper presents comprehensively how the technique of job analysis can be used in relation to an industry to determine the level of work or responsibility from the level of the chief executive to the operator.

Apprenticeship Training in Industry

Dr. N. S. Nandeeswaraiya

Member

Apprenticeship training is not about little boys in short trousers. It is about the way an industrial society restores and builds up its stock of craft workers. Apprenticeship training to meet the requirements of technical personnel at various levels has long been a recognized practice in industry.

The schemes for training professional engineers and technologists in the country are excluded from the purview of this paper. The paper deals with the training of semi-skilled craftsmen who form the bulk of the process workers. Such training is an essential requisite to any production organization, since efficiency, quality and economy of the products directly depend on this factor.

A brief historical review of the trade apprentice system and its evolution to its present form under the impact of socio-economic forces is given. The theoretical and practical requirements of an ideal integrated trade apprenticeship scheme and the factors governing the selection of candidates for training are considered. The utility of IQ and mechanical aptitude tests in the selection of candidates and the desirability of having models to maintain sustained interest in the trainees are discussed. Draft apprenticeship schemes in vogue in industrially advanced countries like the U.K., the U.S.A. and the U.S.S.R. and their merits and demerits are explained. The current facilities in India for training civilian and militarized cadre of craft apprentices and craft apprenticeship instructors are surveyed. The paper concludes with a stress on such factors as financial justification for starting new trade apprenticeship programmes and their immediate necessity, in the present context of low productivity in the country, in the private and public sector organizations alike.

The Metric System—Its Origin, Growth and Impact on Society

J. K. Varshneya

Non-member

This paper describes the origin and growth of the metric system. It explains the chaotic state that prevailed in regard to the use of weights and measures in Europe before the French Revolution, and how it was replaced, under the favourable social conditions created by the Revolution, by the metric system of weights and measures—the first rational and logical system of mensuration based on simple, natural, accurately defined, decimal-based units. The paper also surveys the progress of the metric system and its impact on the scientific and technological activities of the society.

Scheme of Cost Reduction

T. S. Vedagiri

Non-member

In our expanding economic plans, building activity has an important place, and as any other enterprise involving capital expenditure, it requires comprehensive economic analysis. The study of cost reduction is a continuous process which requires logical inquiry into the requirements of the activity before expenditure is committed to at the stage of preplanning as well as during programming and progression of the work on the field. The problem is involved and necessitates effective participation of different technological disciplines. An attempt is made in this paper to spotlight the important factors of building economics on the basis of experience gained by the Committee on Plan Projects, Government of India, in the past few years.

INSTITUTION NOTICES

Non-delivery of mail

Complaints are often received at the Headquarters that letter mail, publications and notices are not being received by members. While in many cases this is due to changes in address, in other instances it is repeatedly found that the addresses as registered in the office are correct and the publications and other mail have been posted in the normal course.

There seem to be reasons for such non-delivery of mail which are wholly outside the control of the Headquarters. One such relates to a police investigation now going on in one district in Calcutta regarding a postman who was apprehended while in the process of selling by weight the monthly *Journal* and *Bulletin* posted to local members instead of delivering them to the addresses. Another relates to the return of mail addressed to members in the Services to the office through the R.L.O., with the inscription 'address incomplete', although whatever addresses are given by these members are inscribed on the address plates.

Every effort is made at the Headquarters, sometimes against great odds such as when the addressograph equipment broke down towards the end of the last year owing to non-availability of spares and the refusal of the Government to grant a license for their import, the possibility exists of mis- or non-delivery of mail when conditions outside the control of the office prevail.

Hindi Section of the *Journal*

Due to unavoidable circumstances, the April 1962 issue of the Hindi Section of the *Journal* will not be published.

Scheme of Institution publications

Details of the revised scheme of Institution publications were given in the *Bulletin* dated May 1961. To facilitate reference, the scheme will be repeated in a tabular form from time to time in the *Bulletin*, as on the reverse of the Contents page in this issue.

Availability of the *Proceedings of the Fédération Internationale de la Précontrainte Congress*

A limited number of copies of the *Proceeding of the Fédération Internationale de la Précontrainte Congress* are available at the following prices :

1st Congress, London, 1953	.. £2 10s (one volume)
2nd Congress, Amsterdam, 1955	.. £5 6s (one volume)
3rd Congress, Berlin, 1958	.. £13 (two volumes)

A reduction of 25% will be allowed on the purchase of the *Proceedings* of all three Congresses. Members desirous of obtaining the copies of the *Proceedings* should contact The Secretary, Federation Internationale de la Precontrainte, Terminal House, Grosvenor Gardens, London, S.W. 1.

Dictionary of prestressed concrete in seven languages

The Dutch study group, S.T.U.V.O., has composed, in cooperation with specialists of the concerned countries, a dictionary of prestressed concrete in seven languages, *viz.*, English, French, German, Russian, Italian, Spanish and Dutch, at the request of the Federation Internationale de la Precontrainte. The publication is priced at £3 (sterling) and is available from the Federation Internationale de la Precontrainte, c/o S.T.U.V.O., Herengracht 507, Amsterdam, Holland.

Draft Indian Standard

The following draft Indian Standard has been issued recently.

Draft Indian Standard Gauging Practice for Metric Screw Threads—Doc: EDC 27 (570).

This Standard gives the gauging practice for Indian Standard metric screw threads.

Members may send their comments on the above draft Standard before May 28, 1962, to Shri B. Venkataraman (*M.*), General Manager, Messrs Praga Tools Corporation Ltd., Kavadiguda, Secunderabad, Andhra Pradesh, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 2/21 First Line Beach, Madras 1; or 14/69 Civil Lines, Kanpur.

FORTHCOMING CONFERENCES

Conference on Components for Microwave Circuits, London, September 1962

A Conference on Components for Microwave Circuits will be held in London in September 1962 under the auspices of the Institution of Electrical Engineers. The scope of the Conference will include research and development work on all types of microwave components and methods to extend their frequency range.

Further details regarding the Conference can be had from The Secretary, The Institution of Electrical Engineers, Savoy Place, London W.C. 2.

Second Symposium on 'Electronic Equipment Reliability,' London, October 1962

The second Symposium on 'Electronic Equipment Reliability' will be held in London in October 1962 under the auspices of the Institution of Electrical Engineers. The following aspects of electronic equipment will be covered during the Symposium.

(i) Operational reliability in electronic systems;
(ii) Economic justification for reliability;
(iii) Attainment of acceptable operational performance with available components;
(iv) System design for a given reliability; and
(v) Reliability and maintenance practices.

Further details regarding the Symposium can be obtained from The Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

International Conference on Satellite Communication, London, December 1962

An International Conference on Satellite Communication will be held in London under the auspices of the Institution of Electrical Engineers. The scope of the Conference covers satellite communication, satellite power supplies, station keeping and altitude control, space environment, orbit characteristics, employment of the moon as a relay station, delay phenomena, propagation, ground-station equipments, aerials, aerial steering, low noise receivers, modulation techniques, avoidance of interference, employment of the radio spectrum, and experience obtained from experimental systems.

Further details regarding the Conference can be had from The Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

International Conference on Aero-Space Support Systems, Washington, August 1963

A Conference on Aero-Space Support Systems will be held at the Sheraton-Park Hotel, Washington, D.C., in August 1963, under the auspices of the American Institute of Electrical Engineers. The programme of the Conference includes an industrial and government exhibition. Members are invited to contribute technical papers for the Conference and take part in the discussions.

Further details regarding the Conference can be had from Mr. S. H. Hanville, Chairman, Technical Society Liason, A.I.E.E. Aero-Space Support Conference, Jack and Heintz, P.O. Box No. 6719, Cleveland 1, Ohio, U.S.A.

BOOK ACKNOWLEDGMENTS

1. **Building Construction.** H. C. Banerjee. Published by the author, 31 Riverside Road, Barrackpore, 24-Parganas, Rs. 4.50. 64 pages.

This book deals with the general methods commonly used for the construction of simple residential buildings in India, particular stress being laid on the methods which avoid dampness.

2. **Hipped Plate Structures—Their Theory and Analysis.** Joachim Born. *Crosby Lockwood & Son Ltd.*, 63 s. 250 pages.

This book is intended to serve as a textbook for advanced study and as a reference book for practicing engineers in the theory and design of hipped plate (folded plate) structures. It deals with both the elementary and advanced approaches to the analysis and design of such structures.

3. **A Textbook of Sanitary Engineering.** V. N. Gharpure. *Allies Book Stall*, Poona, Rs. 12.00. 424 pages.

This book dealing with the theory, design and practice of sanitary engineering is intended to serve as a textbook for engineering degree courses in public health engineering. It covers the characteristics, analysis and methods of treatment of refuse and sewage, and design, construction and maintenance of sewers and drains.

4. **Irrigation for B.E., A.M.I.E., L.C.E., and Certificate Courses.** Krishnaswami. *Prabha Publications*, Madras, Rs. 4.50. 180 pages.

This book presents the basic principles of the methods of irrigation, water lifting devices, requirements of water for cultivation, catchment area and runoff, sinking wells, dams, weirs, sluices and canals, in the form of simple questions and answers.

5. **Rock Mechanics.** H. R. Reynolds. *Crosby Lockwood & Son Ltd.*, 21s. 136 pages.

This book presents a study of consolidated rocks and the link between soil mechanics and mining geology. Physical and structural geology are dealt with from the point of view of stability of excavations, tunnels and structural foundations. Other aspects covered include determination of the physical characteristics of rocks, subsidence, excavation, location of structures in relation to strata, and geophysical exploration.

6. **Polytechnic Applied Mechanics.** H. L. Agarwal. *Saroj Prakashan*, Allahabad, Rs. 10.00. 400 pages.

This book is intended to serve as a textbook for students of diploma courses in electrical and mechanical engineering, and covers the syllabus in applied mechanics as prescribed by the All India Council of Technical Education.

7. **Plant Production Control.** C. A. Koepke. *John Wiley & Sons, Inc.*, $ 11.75, 3rd edition. 373 pages.

This third edition of a book dealing with principles and general concepts of production planning and scheduling of materials has been revised and rearranged to cover first the contributing functions and then the actual functions for controlling the flow of materials in a manufacturing organization. Chapters on the use of digital computers in production control, operations research and data automation, and cycle scheduling have been added in this edition. A suggested outline for installing a production control system is also included.

8. **Applied Mechanics.** Krishnaswami. *Prabha Publications*, Madras, Rs. 6.50. 273 pages.

This book dealing with the general principles of applied mechanics is intended to serve as a textbook for the students of engineering degree and diploma courses.

9. **Applied Mechanics with Strength of Materials and Theory of Structures.** S. C. Neogy. Published by the author, 23/60 Gariahat Road, Calcutta 19, Rs. 12.50. 336 pages.

This book dealing with the principles of applied mechanics, including strength of materials and theory of structures, is intended to serve as a textbook for students of diploma courses in civil engineering.

10. **Machine Design.** N. C. Pandya and C. S. Shah. *Charotar Book Stall*, Anand, Rs. 17.50. 686 pages.

This book deals with basic theory and fundamentals of design of joints and fastenings, springs, bearings, columns and struts, power transmission devices such as gears and pulleys, and miscellaneous machine parts, and is intended to serve as a textbook in machine design for degree courses in mechanical engineering.

11. **Scientific Basis of Electrical Engineering.** J. M. Ham and G. R. Slemen. *John Wiley & Sons, Inc.*, $ 9.95. 816 pages.

This book provides fundamental concepts of electricity and electrical engineering as a basis for study of energy convertion, electronics, circuits, transmission and radiation. It includes electrostatics, magnetostatics, general electrodynamic relations, atomic structure of matter as a basis for interpreting the mycroscopic electromagnetic effects of materials in electrical systems, and application of electrical theory to the analysis of physical systems.

12. **A Guide to the Metric Systems.** V. V. L. Rao. *Asia Publishing House*, Rs. 6.00. 64 pages.

This book is intended to help scientists, engineers and technologists in changeover to metric system, and includes standards, definitions and conversion tables from the existing CGS and FPS systems in the fields of science and technology to the metric system.

13. **Encyclopedia of Business Law and Procedure for Engineers and Contractors.** B. D. Virmani. *N. M. Tripathy Private Ltd.*, Princess Street, Bombay, Rs. 15.00. 422 pages.

This encyclopædia presents in brief business and legal matters of interest to engineers, architects, surveyors, owners or employers, builders, contractors, and others engaged in building and engineering works.

PUBLICATIONS RECEIVED

The following publications have been recently received from the British Constructional Steelwork Association, Westminister, S.W. 1 : (1) 'Steel Frames for Multistorey Buildings' ; the brochure illustrates the application of BS 449:1959 to the design of steel frames for multistorey ; buildings ; (2) 'Composite Construction for Steel Framed Buildings' ; this brochure presents sectional properties of composite sections using universal beams and concrete slabs, suitable for use in steel framed buildings.

A publication entitled 'Tube-well and Groundwater Resources' has been received from the Central Board of Irrigation and Power. In this publication, an appraisal of the mechanics and techniques connected with the development of tube-wells is made, its scope being limited to tapping of groundwater resources for irrigation purposes only.

The following publications have been recently received from the National Buildings Organization : (1) 'Report on Primary Health Centres in Rural Areas' ; the report gives recommendations of the Panel on Health Buildings appointed by the Ministry of Works, Housing and Supply, Government of India, in regard to planning norms, design considerations and model plans ; (2) 'Planning Primary Health Centre Buildings in Rural Areas' ; this booklet gives in brief planning norms, standards and design considerations recommended by the Panel on Health Buildings appointed by the Ministry of Works, Housing and Supply, Government of India ; (3) 'Report on

Higher Secondary School Buildings'; this report deals with planning standards for higher secondary schools and combined senior basic higher secondary schools, recommended by the Panel on School Buildings appointed by the Ministry of Works, Housing and Supply, Government of India; and (4) 'Planning Higher Secondary School Buildings'; this publication gives in brief norms and planning standards for higher secondary school buildings based on the recommendations of the Panel on School Buildings appointed by the Ministry of Works, Housing and Supply, Government of India.

A publication entitled 'Development of the Port of Cuddalore—Hydraulic Model Study' has been recently received from the Central Water and Power Research Station, Poona. It gives details of experiments conducted on a hydraulic model study for the development of the port of Cuddalore.

A brochure entitled 'Water Cement Ratio' has been recently received from Sahu Cement Service. It gives technical information with regard to the significance of water in concrete and its effect on the properties of cement and concrete.

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here

Shri P. V. Ranade

Shri P. V. Ranade, M.I.E., died on September 6, 1961, at the age of 73. He was a Member for life of the Institution.

After passing the L.C.E. course of the Bombay University in 1910, Shri Ranade had his apprenticeship under Shri V. R. Ranade, Contractor, Poona. From the position of an Assistant Engineer, he was appointed Engineer in charge by V. R. Ranade & Co., Poona, in 1918, and became the Director of V. R. Ranade & Sons, Ltd. in 1934. During his professional career, Shri Ranade was responsible for the construction of a number of railway bridges, railway lines and road works.

Shri Ranade joined the Institution as Member in 1945.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

WANTED an engineer to supervise manufacture of bottom bracket axles for bicycles on six spindle automic machine. Should know about case hardening also. Experience about dies and jigs will be considered added qualification. Apply to : Deepak Industries, Gill Road, Ludhiana, Punjab.

THE ADVERTISER wishes to enter into a contract—industrial experience (plant operation) for 9 years in supervisory capacity in heavy chemicals, ammonia and coke ovens, gas plants and fertilizers—for suitable remuneration during studies in the U.S.A. in chemical engineering. Prepared to serve on return for five years after successful completion of studies. (Office ref. E.S. 102)

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THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. SESHADRI, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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Scheme of Institution Publications
(effective June 1961)

Publication	Symbol	Frequency per year	Months during which published											
			January	Feb-ruary	March	April	May	June	July	August	*Sep-tember	October	Novem-ber	Decem-ber
Bulletin	*BU*	12	BU_5	BU_6	BU_7	BU_8	BU_9	BU_{10}	BU_{11}	BU_{12}	BU_1	BU_2	BU_3	BU_4
Civil Engineering Division Part	*CI*	6	CI_3		CI_4		CI_5		CI_6		CI_1		CI_2	
Mechanical Engineering Division Part	*ME*	6	ME_3		ME_4		ME_5		ME_6		ME_1		ME_2	
Electrical Engineering Division Part	*EL*	6		EL_3		EL_4		EL_5		EL_6		EL_1		EL_2
Electronics & Tele communication Engineering Division Part	*ET*	3	ET_2				ET_3				ET_1			
Chemical Engineering Division Part	*CH*	3		CH_2				CH_3				CH_1		
Mining and Metallurgy Division Part	*MM*	3			MM_2				MM_3				MM_1	
General Engineering Division Part	*GE*	3				GE_2				GE_3				GE_1
Hindi Section	*HI*	3				HI_2				HI_3				HI_1

Figures appearing as subscripts indicate issue numbers.

* A new volume commences in September each year and ends in August next year.

TECHNICAL EDUCATION IN THE U.S.S.R.*

Dr. V. M. Dokras

Member

1. To understand anything about the U.S.S.R., one must first appreciate the vastness of the country, wide cultural variety of the people living in it, its immeasurable natural resources, and the political philosophy of the people.

2. It is a vast landmass lying between 20° and 170° longitudes and 40°N to 80°N latitudes. It consists of 14 republics with population of about 220,000,000. It has large iron, coal, bauxite, copper and chromium deposits, and contains one of the largest power potentials of the world, which is rapidly being converted to reality.

3. Upto 1917, it was being ruled by the Tsarist monarchy which was swept away by the October Revolution. A socialist government finally came into being under the leadership of the communist party whose motto was 'From each according to his ability to each according to his needs.' The odds facing the government were very heavy. More than 70% of the people were illiterate and only 20% of the children were attending schools. There was no facility for learning in their own language in most parts of the country. In 1914, only 9,650,000 attended elementary and secondary schools and 181,000 higher and technical schools. The total number of students in the various universities was 11,431. In the field of education, the country lagged far behind the world, and the total number of students as percentage of the population was one of the lowest.

4. From this stage, in a span of 45 years, including a devastating war which was won at a heavy cost, the progress in the field of education in the U.S.S.R. has been such as to make even highly progressive countries review their programmes of education in the light of the Soviet experience and efforts. The system of education has aroused admiration, curiosity, investigation and also criticism in all progressive countries of the world.

5. The entire development can be broadly divided into two periods, the first from 1917 to 1941, and the second from 1945 to date, the two periods sandwitching the Second World War. Let us consider the first period. Lenin realized from the begining that without guidance of specialists in the various fields of knowledge, technology and experience, the transition to socialism will be impossible. It was, therefore, with the production of these specialists that the nation busied itself. A series of reorganizations were adopted, important of which being (i) selection of scientists and teachers, (ii) establishment of State learned councils, and (iii) institutions for training of professors. The material standards of scientists were reconsidered by the Central Commission with Maxim Gorky as its Chairman, and by the time the Second Plan was launched in 1933, about 26,000,000 students were attending various institutions. It was realized that opportunities to workers for further study will release education from the dead end to which it comes after a student starts working. In 1938, universal secondary edu-

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* Lecture delivered at the 42nd Annual General Meeting, Calcutta, on February 4, 1962.

cation was introduced and the facilities for higher education were improved. In 1940, 30,100 graduates in industry, building and transport, 10,300 in agriculture, 5,700 in economics, 62,700 in education and arts, and 17,400 in public health and physical education were produced.

6. It was realized that unless post-graduate education was increased, with emphasis on preparing a specialist with broad general and technical background, the task of supplying teachers and better category of workers for the industry will not be properly achieved. In 1938, there were 228 institutions of higher learning and 267 research institutions which produced about 9,000 post-graduate students, comprising 2,748 in industry and building, 662 in transport and communication, 849 in agriculture, 2,296 in education, 661 in socio-economic disciplines, 270 in arts, and 1,689 in public health. The percentage of women in the post-graduate students was 30.6 and the percentage of communist party members 25.1.

7. During the war, the educational facilities received a great blow. More than 334 institutions of higher education and 600 research establishments were destroyed. Large number of teachers and students were displaced, killed or otherwise removed from the educational field. Loss of equipment and buildings was incalculable. But, even with this setback, the task of rebuilding the shattered educational organization was taken in hand so capably that in 1955-56, the number of students in higher institutions was 1,867,000, as compared to 602,000 in 1939. From 1950 to 1955, more than 112 new institutions were opened. During this period, the system of extra-mural institutions and evening higher education was stressed. In 1957, there were 22 separate extra-mural institutes and 620 extra-mural departments with 3,500,000 people using these facilities. The courses for post-graduate studies were specially reorganized to take into consideration the research requirements of the nation. The increase in post-graduate education was phenomenal. As compared to 16,700 in 1946, there were 46,000 students in 1956. The emphasis also changed considerably during this period. Technical sciences such as physics, chemistry, geology, and medicine found more favour than history and law. The main difference between the old courses and the new was the introduction of narrow specialities in the various branches to take care of the national requirements. Thus, engineering sciences had 200 specialities, chemistry 7, transport 13, geodesy 31, building 14, pedagogy 27, medicine 29, etc.

8. Post-graduate courses in the U.S.S.R. are of three years duration for full time work and four years for extra-mural work. These are broadbased and consist of (i) general theoretical grounding, (ii) special theoretical grounding, (iii) scientific and theoretical research and experience, (iv) practical work in production, scientific trips and excursions, (v) work on thesis, and (vi) teaching practice. Teaching practice is the unique feature of the Soviet system. A student, after post-graduate studies, has to shoulder teaching responsibilities, and if he is not engaged in actual teaching in classes, he has to transfer knowledge to his subordinates in industry. It is in this that the special training is of great use to him and to the nation. Teaching practice continues throughout the course and includes study of theory of pedagogy, psychology, methods of teaching special disciplines, observations, conduction of actual classes in theory and practicals. Every post-graduate student is attached to a Chair and has to take part in

the methodological work of the Chair. At the end of the post-graduate training, he qualifies for the Candidate's degree. The final examination is conducted by a board consisting of professors and assistant professors.

9. The requirements for Doctorate degree are laid down on a national basis by a special decree of the Government and consist, in addition to finishing a prescribed course of studies and research, of public defence of the thesis. It is possible for the Higher Certifying Commission of the U.S.S.R. to confer Doctorate upon a famed scientist or engineer without defence of a thesis.

10. study of the number of candidates and doctors and their distribution in the various disciplines during the periods 1937-40 and 1952-55 is given below.

Discipline	No. of doctors		No. of candidates	
	1937-40	1952-55	1937-40	1952-55
Physics and mathematics	155	180	755	1,902
Chemistry	109	184	499	1,714
Engineering	514	684	3,786	11,996
Agriculture	94	198	668	2,467
Medicine	1,106	677	3,942	6,016
Total	2,703	2,883	12,553	44,636

11. An analysis shows that out of the total number of candidates, 29.1% were in engineering, 18% in medicine, 7.3% in history, and 6% in agriculture.

12. The year 1948 is memorable in Soviet education. During this year, the Act to establish closer links between school and actual life was passed and applied throughout the country. The main defects of the old system were (i) divorce of schooling with actual life, (ii) necessity of schools assuming greater share in the creative activities of the nation, (iii) necessity for increasing the scope of education, (iv) inadequacy of skill and technical standard of workers, (v) necessity of giving a more broadbased education, and (vi) increasing employment opportunities through extra-mural system. One of the main results of the Act was to increase the span of the secondary education from seven to eight years on a national level.

13. It would be better to survey the entire system and then examine some of its salient points. Education in the U.S.S.R. starts with four years of kindergarten education from the age of three and continues for eight more years through the school of general education which is called 'incomplete school of polytechnical education.' The syllabus is divided into 43.2% humanities, 35.1% science and mathematics, 15.1% manual training, and 6.5% physical culture. After this, the student has three avenues open to him.

If he decides to go to industry, he joins a vocational technical school with a three-year course. These schools are mostly attached to productive units. If the student desires to go to university for higher education, he joins either a secondary polytechnical school of general education or a technical and specialized school, both of three to four years duration. Work training and production training form 31.7% of the total curriculum of these schools. The institutes of higher education provide five-year diploma courses (first degree). There are at present 40 universities, 20 technical institutions, 100 agricultural institutions, 47 art institutions, and 753 other institutions in the various republics of the U.S.S.R. The universities are mainly concerned with arts and sciences while technical education and training is the concern of the polytechnics and special institutions. In addition, correspondence institutes, evening and part-time courses and correspondence departments of the regular institutions take care of more than 1,000,000 students.

14. Let us now consider some special features of the Soviet education system, with particular reference to professional education. The system is completely integrated with the People's Plan, both at the top and bottom. The educational requirements of the population and the targets of production in various departments, for national defence, wellbeing and an ever-increasing standard of life, form the main components of the system. This integrated planning and the insistence on achieving set targets have resulted in an evergrowing tempo of work. The tangible knowledge of the responsibilities to be shouldered, with continuous practical bias in the same line during instruction period, has resulted in a more purposeful education, though in narrow specialities.

15. Planned preparations for making space, equipment, and staff available at the right time have resulted in very high standards of instruction. Establishment of short term courses to supplement the regular course, when need in any speciality is experienced, is a unique feature of the system.

16. The availability of part-time, evening or correspondence courses enables the average worker to lead a purposeless life, improve his academic as well as economic status, and thus become progressive. The equality of the diplomas obtained through a regular course and a part-time course has removed the last hurdle in the future progress of the worker. In many instances, the part-time course diploma is preferred over the regular diploma as it is considered to have greater practical experience. It also enables the lesser endowed to come up to the accepted standards slowly but surely. It was found that the average intake of part-time evening departments was as high as one-third of the intake in regular courses. Part-time students can have regular consultations with staff and are entitled to paid leave for completing the practical requirements and also to prepare and appear for the final examination.

17. Let us now study the examination system. Examinations are both oral and written, and are conducted by professors and dozents as a normal part of their duties. The maximum number of students that a professor examines in one day is 16, and the grades are given as 5, 4, 3, 2 and 1, the last two being 'fail' grades. This combination of written and oral examinations makes the system rational and gives a true picture of the attainments of the student. There are no final practical examinations as in our country. The

laboratory work is rigorously conducted with oral questions and answers at the time of examining the practical record, thus removing the necessity for final practical examinations. The impossibility for a student to continue his studies if he fails more than once is a good deterrent to waste of time by him.

18. Every student is given stipend varying from 30 to 78 Roubles a month to defray the cost of lunch, extra books and other requirements. This concession is given to all students except those who fail and whose parents' income is above a certain limit.

19. Let us now consider the organization of the diploma, candidate and doctorate courses. The programme of work in diploma courses is set by the pattern laid down by the Ministry of Higher Education. These patterns, with detailed instructions regarding time distribution and syllabuses, are prepared by expert committees. The programme can, however, be altered to suit local requirements to a certain extent. Admissions to diploma courses are determined by the achievements of the student at the admission examination, his previous record—scholastic and practical—and the character certificates given to him by the heads of the educational and industrial organization from which he has come. In the later stages of the five year programme, the student has to work in productive or social fields. As stated succintly by the vice-chancellor of a university in the U.S.S.R., 'It is very necessary to impart the student knowledge but it is still more important to find out what he can do with that knowledge.' On an average, the student works two days of four hours each every week on his practical assignment in the later part of his five year programme.

20. Recently, the entire curriculum of the diploma courses has been revised to suit modern requirements. The most important factor has been the increase in the content of science and mathematics in the curriculum. Generally, out of the 7,000 hr. of work during the five year period, 1,600 are spent on non-technical subjects, 1,100 on basic technical subjects, and 4,300 on the speciality. The number of hours for mathematics are about 455 and physics about 315 during the period. The use of modern process controls, advances in technology and new materials have necessitated this increase in the teaching of physics, mathematics and chemistry. Close integration of practical work, works training and theoretical subjects has resulted in more time being available for pure science subjects without reducing the quality of the final product. In fact, this has resulted in faster understanding of the theory and a superior insight into all its aspects. With still greater integration of theory with practice, further time can be saved for strengthening the base of the knowledge.

21. At the post-graduate level, admission is strictly competitive and the efforts which had to be made in the beginning to make available a large number of teachers, research workers and superior staff have borne fruit. The vital necessity of raising facilities for post-graduate work was initially recognized. The increase in undergraduate and graduate studies have made the systems more balanced and complementary to one another. Research is generally organized according to the approved programme drawn at the highest level. This programme is a part of the national plan and is continuously assessed and revised. One of the specialities of the Soviet system is the establishment of special institutions such as the Steel Institute, the Energy Institute

the Aluminium Institute, etc., and problem laboratories throughout the nation. These institutes, in addition to providing post-graduate training facilities, have permanent research staff and are very well equipped. The minimum time gap between the formulation of a research programme and its execution depends on the axiom that the standard of life of the people can only be raised through modern technology and latest production methods, and this depends on a continuous effort to know and improve, which can only be done by a team of well trained scientists and engineers accepting it as a challenge of the future.

22. Let us now review the employment conditions. Every student in the U.S.S.R. knows that a job is assured for him in accordance with his speciality. Every year in the month of April a list of jobs available throughout the country is sent to each institution. A commission consisting of heads of the institutions and their deputies, representatives of the Ministry of Higher Education and trade unions scrutinize the applications for various placements. The progress of the student, his domicile and his preferences are taken into consideration before a decision regarding his posting is made.

23. It will not be out of place to point out the quantum of expenditure on education in the Soviet union. The total expenditure on education in 1940 was Rs. 121.5 crores and in 1960, about Rs. 470 crores. The annual budget of the Moscow University is Rs. 1.8 crores, Leningrad Polytechnic, Rs. 0.6 crores, and Kiev University, Rs. 2.6 crores. Professors get a salary of Rs. 2,200, heads of departments about Rs. 2,500 and assistant professors Rs. 1,750 per month.

24. The main specialities of the Soviet education can thus be summarized as (i) close integration with life's productive and social processes, (ii) complete lack of unemployment, the student knowing his future employment during the course of his studies, (iii) very effective and well organized system of practical training, and (iv) uniform standards and unlimited opportunities for research. Special efforts are made to prepare teachers in different subjects by including a pedagogy programme at the post-graduate level. The establishment of special institutes makes it possible to undertake and execute research projects in an efficient manner with close cooperation of the industries. Special efforts are made for the preparation and publication of text-books at all levels. Provision of stipends makes education available to every deserving student. In all, this gives an idea of the organization geared to the efforts of the nation to better its standards of life.

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ROLE OF ENGINEERS IN THE THIRD FIVE YEAR PLAN

S. K. Nanavati
Non-member

Introduction

We are on the threshold of the Third Five Year Plan. While it is not necessary to go into the details of the Plan, I have no doubt that the targets laid in the Plans could not have been achieved but for the important and vital role played by engineers, technologists and craftsmen. Though it may take more than a decade to secure the right type of scientific and technical personnel in required number to build the human resources necessary for productive execution of the Plans, it is important that we should analyze the existing engineering personnel and the role they are required to play, so as to be able to determine whether the available manpower is being fully and effectively utilized.

Sound technical education—a pre-requisite

Technical education should be deep rooted and should form the hard core of planning to ensure the successful implementation of our objectives towards the establishment of a socialistic pattern of society. The Government of India have stated in their scientific resolution of March 4, 1958, 'The key to national prosperity, apart from the spirit of the people, lies, in the modern age, in the effective combination of three factors—technology, raw materials and capital—of which the first is perhaps the most important since the creation and adoption of new scientific techniques can make up for deficiency in natural resources and reduce demands on capital. But, technology can only grow out of study of science and its application.' The resolution further states that the scientific and engineering personnel should be recognized as an important component of the strength of the nation.

The Prime Minister, while inaugurating the 10th Annual Assembly of the World Confederation of Organizations of Teaching Profession in New Delhi in August 1961, said 'We are acquiring a mountain of learning without much wisdom'. He made a reference to the theme of the Conference, 'Education for Responsibility', and asked the delegates to consider the question of responsibility to manage institutions and other concerns.

The Working Group on Technical Education and Vocational Training has stated that quantitative expansion of technical education is only one-half the effort and, therefore, it is equally important to set new standards, examine the existing patterns and suggest new methods of organization from the point of view of greater economy and efficiency. The opportunities that have been created in the country call for new methods of training, teaching and organization in the field of technical education. Prof. Humayun Kabir, Union Minister for Scientific Research and Cultural Affairs, has made frequent references to the need for qualitative improvement and provision of diversified courses in technical education in the context of rapidly increasing industrialization of the country. The Association of Principals of Technical

Institutions (India) and the All-India Council for Technical Education are now contemplating to bring about changes in the pattern of technical education in order to meet the increasing demand for engineers in the country so as to be able to achieve the targets that have been set in the Third Plan. I have no doubt that within the next 10 years, we will be in a position to lay a firm foundation for technical education in the country. It is heartening to see that technical education has been given topmost priority by the planners and an amount of Rs. 142 crores has been allocated to education in the field of engineering and technology. As against 13% and 19% in the First and Second Plans, respectively, technical education represents about 25% of the outlay on education in the Third Plan.

Programme for expansion of technical education

The following table gives a summary of the progress so far achieved in the field of technical education and the programme for the Third Plan.

Table 1

Admission capacity and outturn of engineering colleges and polytechnics

Year	Degree courses			Diploma courses		
	Number of institutions	Admission capacity	Outturn	Number of institutions	Admission capacity	Outturn
1950-51	49	4,120	2,200	86	5,900	2,480
1955-56	65	5,890	4 020	114	10,480	4,500
1960-61	100	13,860	5,700	196	25,750	8,000
1965-66	117	19,140	12,000	263	37,390	19,000

The rapid increase in the outturn of engineers and technologists indicates that we are not lagging in the field of technical education. The Third Plan also includes provision for part-time and correspondence courses. With a view to meet the likely demand for engineering graduates and diploma holders in the Fourth Plan, educational facilities will be created during the Third Plan during which 17 additional colleges, including seven regional engineering colleges, will be opened. Eight regional engineering colleges were approved for the Second Plan, of which seven have started functioning. Each of these colleges has an admission capacity of 250 students. They will also provide for training in special branches of engineering and technology such as mining, metallurgy, chemical engineering, etc. The Third Plan provides for 67 new polytechnics, each with an admission capacity of 180 students or more. In addition, wherever feasible, the capacity of the existing institutions will be expanded. Side by side with the expansion of technical education, importance has also been given to adequate supply of qualified teachers, which is the most important pre-requisite for the development of technical education. It has also been recognized that training of craftsmen is the backbone of industrial development. During the Third Plan, it has been estimated that about 1,300,000 craftsmen will be required, consisting of 810,000 in engineering trades and the remaining in non-engineering trades. The facilities of evening classes for employed industrial workers will also be increased from about 2,000 to over 11,000. With the development of post-graduate studies in engineering and technology, a large number of persons have specialized in various branches and will be available for the teaching profession. With the introduction of higher secondary schools uniformly throughout the country, which directly gear to university courses in engineering and technology, it is expected that students will find the right place in industry, agriculture and other fields, and will become productive elements in their respective fields.

Practical training of engineers

For an engineer to be useful and productive to industry or in any other field in which he is employed, practical training after graduation forms the basis for his development. It is the responsibility of the industry to recognize that the university does not train a student to be an engineer but it trains a student for engineering profession. Training in the application of the principles of engineering is almost solely the responsibility of the industry. College education can do no more than build the intellectual sensitivity of the student. Development of the skills takes place only after exposure to the light of practical experience. With a large number of engineers graduating every year in the years to come, this problem will assume greater proportions. Practical training should therefore be viewed as an important tool of management for raising the productivity. Without practical training, effective utilization of the skills and fundamental knowledge of engineering cannot be achieved.. A comprehensive scheme for the training of engineers should be based on sound university education, followed by a pre-employment training in industry for one to two years during which they should be given a systematic training in accordance with the requirements of the industry, including basic management. This period should be followed by one to two years of employment, professional identification and integration into the community in which the industry is located. During this period, the engineer should associate himself with professional bodies in order to achieve the maximum benefit from the experience of other professional engineers. After this period, he should continue to develop in the industry and be productive for the enterprise, both in terms of technical ability and managerial functions. Such a plan, if properly implemented in various industries in the country, will bring about increased productivity, effective utilization of manpower and fulfilment of the targets of the Plans. Unfortunately, many industries in the country do not have a planned technical training programme. The employers will do injustice to the engineering profession and to the country if they think only in terms of immediate return on employment of a fresh engineering graduate without a systematic practical training suited to the needs of the industry. It may not be out of place to mention here that the systematic programme of training that has been evolved in the Tata Iron & Steel Co., Ltd., Jamshedpur, over the past 40 years, shows what industry can do for effective development of graduates in engineering and metallurgy and employ them on a productive basis rather than hurry them through a process of employment which will ultimately result in a routine mediocre technical assignment without giving them much chance to develop in their respective fields. The Working Group on Technical Education and Vocational Training has recommended certain steps to be taken to ensure that graduates in engineering and technology are given pre-employment training for productive employment. The supervisory training programmes in Tisco will go a long way in meeting some of the difficult situations in managerial functions.

Legislation on apprenticeship training

A majority of industries in the country have not been able to give adequate facilities for practical training of students of technical institutions. In fact, in a majority of engineering institutions it is no more compulsory for the students to undergo practical training before the award of a degree or diploma, with the result that theory is completely divorced from practice. It is in this context that a Bill has been introduced in Parliament to legislate apprenticeship training. It is too early to say what results the proposed Act will bring about, especially when many industries in the country do not have a sound and systematic management. Technical training will not, therefore, be understood by such employers in the proper sense of the term. It is also too early to say whether a compulsory apprenticeship scheme can be worked effectively, unless it is put into force.

Place of engineers in national planning

It has been often said that engineers are not associated with national planning. The *modus operandi* of official planning suggests that by and large professional engineers have little to do with the actual formulation of the Plans. It appears that the Government does not fully believe that engineers are capable of making policy decisions or advising them on the needs of the society arising out of technological changes. In other words, engineers are treated as artisans in the execution of the Plans. In the Second Plan, however, the late Dr. J. C. Ghosh, a member of the Planning Commission, addressed individual letters to professional engineers requesting them to intimate if they had any proposal to offer on the Second Plan and also to let him know what new industries should be set up in the country at various levels, such as cottage, small scale and heavy industries. Prominent engineers were invited to attend seminars on the Second Plan conducted under the auspices of the Federation of Indian Chamber of Commerce and Industries whose views were also considered by the Government. It is important that professional engineers should not remain unconcerned with national planning. They should give concrete suggestions and constructive criticism in the field in which they are competent. There are agencies such as the Indian Engineering Association, the Federation of Indian Chamber of Commerce and Industries and other Chambers of Commerce through which such contributions can be made.

Engineers as consultants

It is hardly necessary to mention the paucity of Indian consulting firms to cope with the requirements of the country. With the exception of about six consulting firms, there are practically no facilities for consultations on setting up of industries or industrial problems in the country. The country's progress depends on consulting engineers readily available to those concerned with the industrialization of the country. It is unfortunate that large sums of money are being spent in the form of precious foreign exchange by entrusting the work to foreigners even for small projects.

Manpower planning

A manpower survey made by the Engineering Personnel Committee appointed by the Government of India shows that the estimates have fallen short of the actual requirements, especially in the category of skilled workers and technicians. Here also, engineers could have assisted the Committee in a spirit of service and given their views and suggestions. A proper manpower survey is a pre-requisite to the execution of the Plans and is an integral part of planning for the development of materials, equipment, power, and other resources. Manpower is the key resource required for economic development. Managers, engineers, technicians and skilled workers create, control and operate the enterprises and institutions which are essential for industrial and economic development. Even for manpower survey, we have to depend on foreigners. Experienced engineers in managerial positions can undertake such surveys in their respective fields and assist the Government in assessing the requirements of engineers, technicians and skilled workers for the execution of the Plans. Materials, equipment, power and money can be effectively utilized only if manpower capable of processing them into useful goods and services is available.

Design engineers

The right quality and number of design engineers are not available in the country, though there is some evidence that we are slowly in the process of forming a corps of design engineers capable of meeting the demands. The subject 'design' forms an integral part of the degree courses in engineering today. It is time that engineering colleges should concentrate on designs as a speciality for engineering students. It is important to take concrete steps to ensure that the country does not depend on design engineers from abroad.

Cottage and small scale industries

Sometime back, Dr. B. C. Roy, Chief Minister of West Bengal, exhorted the young engineers who went to him for jobs that a time has come when they should think in terms of starting small business by availing the facilities provided by the Central and the State Governments for small scale and cottage industries in regard to technical know-how, equipment, raw materials and marketing facilities. If our engineers can divert their attention to this field instead of hunting for jobs, much can be achieved. A large portion of the money earmarked for small scale industries remains unspent.

Link with technical institutions

Tisco have pioneered a scheme whereby a closer link between industry and technical institutions can be established. Last year, three professors in the fields of metallurgy, electrical engineering and mechanical engineering were invited with a view to enable them to see for themselves the application of theory into actual practice so that on return to their institutions they could give the necessary slant in the teaching of engineering subjects. Besides, the supervisors got a chance to discuss with these professors the latest developments in the field of engineering and technology. The result has been a two-way communication between the professional engineer and the professional teacher. The ultimate objective of the scheme is to encourage university professors to become consultants to industries. In this manner, it will be possible for industries and technical institutions to get closer and make the system of technical education more productive.

Engineers and productivity

With the establishment of the National Productivity Council and its regional centres in the country, employers, engineers, technicians and others in the field of production, both agriculture and industry, have been made conscious of productivity. Vast amount of literature is available on the subject. Specialists in the field are invited from time to time to advise the Government and other industries on methods to improve productivity. If all that has been said about productivity is analyzed, the conclusion is reached that it is incumbent on the engineers to understand the importance of productivity and work hard for it. In the Third Plan, training facilities for meeting the requirements of technical and managerial personnel for village and small scale industries have been considerably enlarged and emphasis is being laid on the introduction of improved tools and equipment for higher productivity. Engineers can contribute vitally towards improving the productivity and reducing production costs by improving the skill of the worker, giving technical advice, using better equipment, etc. Increased productivity will bring better living and working conditions for workers, increased employment opportunities and a fuller measure of social security. The vicious circle of poverty, unemployment and low productivity can to a large extent be broken by engineers and technologists through maximum contribution to the process of production.

Engineers as administrators

I give below an extract from 'Engineers and Management' by Sir Ewart Smith.

'If we turn now from management in general to engineers as managers, it would appear that the basic training and subsequent experience which are normal for the professional engineer should be pre-eminently suited to the development of good managerial qualities. Every engineering activity has a clear and immediate purpose, the achievement of which demands planning, decision and control. The engineer is brought up on the idea of change and progress. He has to carry responsibility for his work and results more directly than in almost any other profession; his mistakes are there for all to see, and he has either to correct them or live with them—a most salutary fact. Engineering too, always depends on cooperative action with other people. The engineer is exceptional also in having the opportunity to see management from the underside, and to gain experience of rank and file reactions during his period of practical training. Thus, the professional engineer should be peculiarly well equipped to undertake wide managerial responsibilities. It is beyond question that he normally does so with success in his own field.'

Nevertheless, in spite of these inherent advantages, engineers in the country are not numerically outstanding in the field of senior management in industry or the Government. Attention was drawn to this position by Mr. Bosworth Monck in his paper 'The Status of the Engineer in Management,' read before the British Association in 1954. He said, 'Even in the engineering industry proper, 40% of the companies had Boards with no technically qualified member, and that of all the directors of engineering companies, less than 22% had technical qualifications, and of these, only three-quarters were engineers. In the field of general industry, including services such as transport, in spite of our growing dependence on mechanization and engineering in some form or other, the position is, of course, worse. If we look still wider—at Parliament as the national level of management—we find that it is rare to have even one qualified engineer in a ministerial post.'

I am not certain of the conditions in India in this matter since no statistics are available. I have no doubt that at least in the private sector, professional engineers have become good managers. Our economic problems can be solved only by greater application of science and technology. Our future progress, therefore, requires engineer's technical knowledge and potential aptitude for management should be recognized and used to the fullest extent.

Indian engineers abroad

The Ministry of Scientific Research and Cultural Affairs maintains statistics of Indian engineers working abroad. Appeals have been made to them to return to India and contribute to the national development, but the response has been very poor. The Prime Minister in one of his visits to the U.S.A. made an appeal to Indian engineers to return to India and be associated with the adventure of building a new India. The Government is the largest employer of scientific and technical personnel. Recent statistics reveal that private sector employs about 8% post-graduate scientists, 20% engineers and 36% technologists, thus making use of only about 15% to 20% of the total scientific and technical personnel. The task of utilizing the engineers and scientists who have been trained abroad, therefore, rests on the Government. A realistic approach to the problem must be immediately made in order to attract the large number of engineers and scientists who have so far preferred to stay abroad. Out of the 3,208 Indian registrants abroad, scientists form 28%, technologists 10%, engineers 53%, and medical specialists 9%. These figures are based on the analysis of registrants upto 1959 in major fields in various countries. Out of the total number, the U.S.A. accounts for about 1,000 and the U.K. about 1,100. This number is sufficiently large to warrant a detailed planning on their utilization in India at a time when we are faced with acute shortage of specialized technical personnel in various fields.

Conclusion

Industry has a leading role to play in securing rapid economic advance. Engineers can bring about rapid technological changes by adopting scientific agricultural practices, improved implements and industrial equipment. Development of industries is an essential condition for self-reliant and self-sustained growth. A high potential capacity to produce basic materials such as steel, cement, heavy machinery, fertilisers and electrical goods is needed for the development of the country. In turn, these will stimulate the growth of medium and small scale industries and will ultimately result in increased employment both in urban and rural areas. With the extensive resources of iron ore, manganese, bauxite, coal, mica and atomic materials, there is no limit to our industrial progress, but we are lagging in tapping these resources. The economy of the large and small scale units should be brought closer to ensure a high degree of mobility, self-generating economy and economic integration. It may take more than two decades to secure the required outturn of scientific and technical personnel and build up the necessary foundation for scientific research. It is equally important that the available manpower should be utilized fully and effectively. With free and compulsory education, we can expect a marked progress in the years to come. An essential aspect of our long term planning should be speedy means of increasing the level of productivity. At the base of this mighty effort are the engineers, technologists and craftsmen, whose contribution is vital for raising the standard of living of the people, be it in agriculture, indusry, teaching profession, scientific research, or economic development. The Prime Minister has said in no unmistakable terms, 'The world in which we live today calls for industrial growth in order that we may live.'

Contemporary World Engineering Projects Series—21

Members are invited to contribute to this Series special articles featuring major engineering projects which they may have visited or with which they may have been associated in any other manner. Articles should be preferably accompanied by photographs and illustrative sketches.

The High Pressure Steam Plant of the Empresa Nacional Siderurgica S.A., Spain*

The high pressure steam plant of the steelworks of Empresa Nacional Siderúrgica at Avilés, Spain, supplies both power and high and low pressure steam. Part of this steam is used in the turbines which drive the blast furnace blowers, and the rest feeds the transformers which provide secondary steam for the works supply network. The boiler plant comprises four Sulzar monotube units, each with a maximum continuous rating of 125 tonnes per hr. at 95 kg. per sq. cm. and 52°C. The available fuels are blast furnace gas and an intermediate product of high ash content from the coal washing installation.

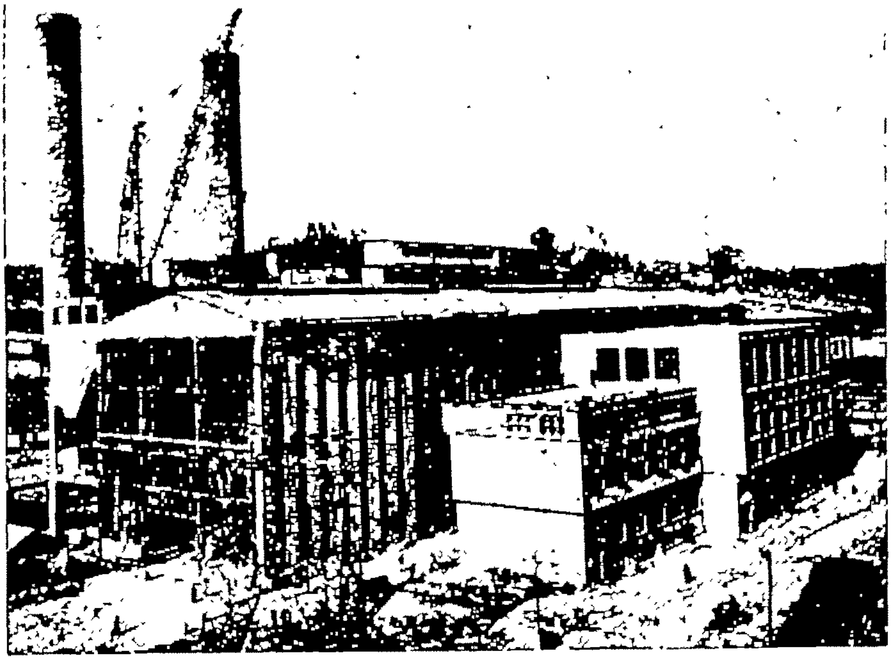

Fig. 1

General view of the high pressure steam plant of the Empresa Nacional Siderurgica

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* Compiled from publications made available by the courtesy of the Sulzer Brothers Ltd., Switzerland.

The Empresa Siderúrgica S.A. has an annual output of 700,000 tonnes of rolled products. Avilés in Austria was chosen as the site for this works because of three main advantages ; (i) it has a natural, sheltered harbour for unloading the iron ore and shipping of the finished products, (ii) it lies only 40 to 60 km. from the Austrian mines which supply the coking coal, and (iii) it possesses rail communications with the Austrian industrial centres and the rest of Spain.

The following installations were erected in the first building phase :

(i) Coal preparation plant ;

(ii) Battery of 120 coke ovens ;

(iii) Ore dressing plant ;

(iv) Two blast furnaces with a combined maximum output of 3,200 tonnes per day ;

(v) A pig casting machine with an output of 120 tonnes per hr. ;

(vi) A 600-tonnes mixer ;

(vii) Three Siemens-Martin tilting furnaces of 300 tonnes capacity each ; and

(viii) Two stationary Martin furnaces of 225 tonnes capacity each.

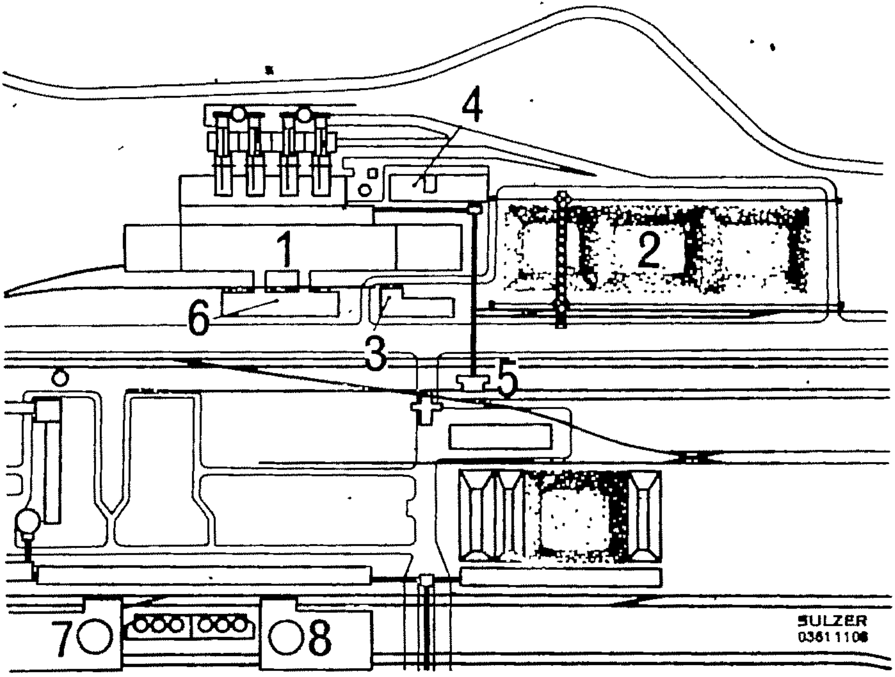

Fig. 2

General plan of the steam plant

1, steam power station ; 2, coal storage yard ; 3, canteen ; 4, water purification plant ; 5, wagon tippler ; 6, substation and offices ; 7, blast furnace no. 1 ; 8, blast furnace no. 2

The steel produced is further processed in a blooming mill, section and rail rolling mill, plate and sheet mill, and cold rolling mill. The by-products of coke production are taken to a chemical plant for further processing.

The steam plant is situated in the proximity of the blast furnaces on the northern edge of the works (Figs. 1 and 2).

The transformers which raise the alternator voltage from 10.5 kV to 50 kV are located in the open space between the distribution station and the machine hall. A distribution network operating at 50 kV supplies the remote parts of the works. A connection to the outside mains enables transfer of power between the works and the public supply at all times. A 6.3 kV network serves the auxiliary equipment of the station and the installations near the works.

The machine hall houses the two steam turbine driven blowers each of which delivers 150,000 m.^{3} per hr. at 2.46 kg. per sq. cm., in addition to the 7.5 MW ,30 MW and 60 MW turbo-alternator sets (Fig. 3).

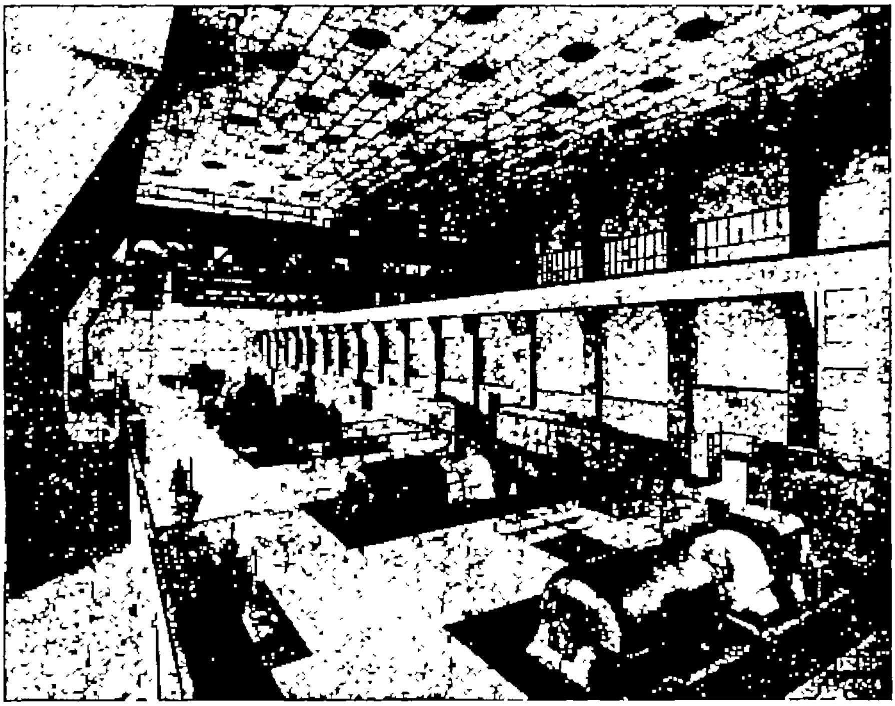

Fig. 3

A view of the machine hall

The layout of the plant has been planned to ensure supply of steam to the turbines driving the two blowers even when the individual boilers or the 7.5 MW back pressure set is out of action, so that there is no danger of interruption in the supply of blast to the furnaces.

Each boiler is connected to a turbo-alternator set; boiler 1 to the 7.5 MW set, boiler 2 to the 30 MW set and boilers 3 and 4 to the 60 MW set (Fig. 4). The boilers are also connected to a common high pressure header. During normal service, the valves between the boilers 2 and 3 remains closed so that the plant operates with boilers 1 and 2 as block 1, and boilers 3 and 4 as block 2. In the event of malfunction of boiler 1, the 7.5 MW set is fed from boiler 2, whilst the load on the 30 MW set, which works with admission pressure control, is reduced. If trouble is experienced with both boilers of the block 1, the supply of steam to the back pressure set can be still maintained, since boilers in block 2 can be utilized by opening the valves in the high pressure header.

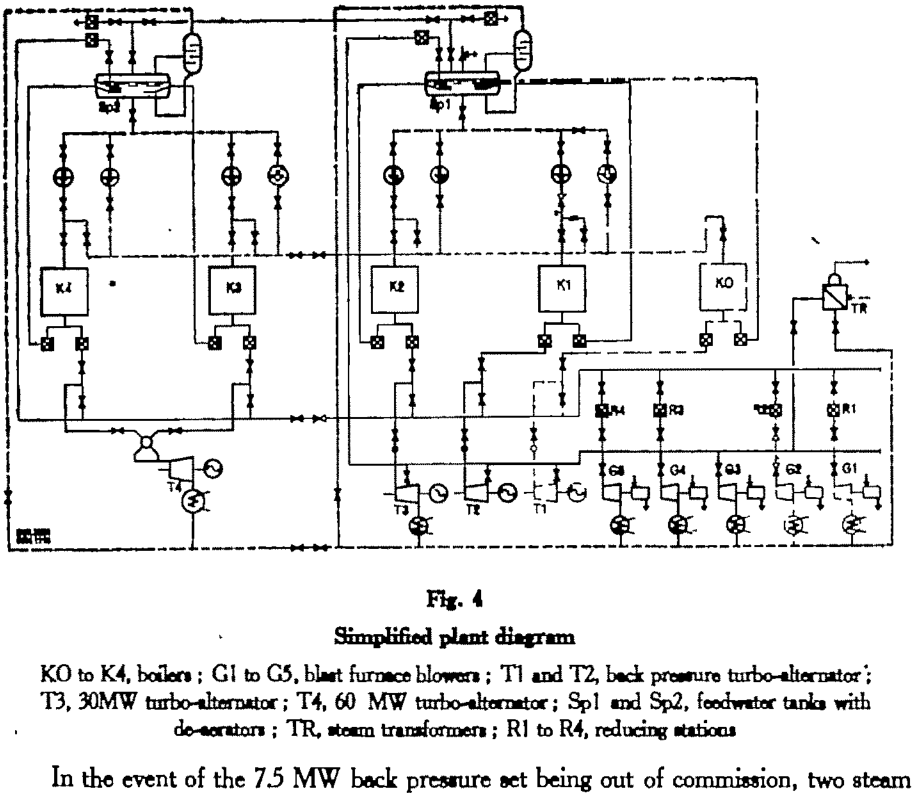

Fig. 4

Simplified plant diagram

KO to K4, boilers; G1 to G5, blast furnace blowers; T1 and T2, back pressure turbo-alternator; T3, 30MW turbo-alternator; T4, 60 MW turbo-alternator; Sp1 and Sp2, feedwater tanks with de-aerators; TR, steam transformers; R1 to R4, reducing stations

In the event of the 7.5 MW back pressure set being out of commission, two steam pressure reducing stations maintain the supply of steam to the turbo-blowers and the steam transformers which provide slightly superheated steam at 25 kg. per sq. cm. for process purposes. The feed pumps in the two blocks are likewise interconnected on the pressure side so that boiler feed is assured even when the individual pump sets break down. The condensate from the turbo-alternator sets, turbo-blower sets and steam transformers is divided between the feedwater tanks of the two blocks either manually or automatically. The back pressure set supplies 125 tonnes of steam per hr. at 32 kg. per sq. cm. and 430°C. The 30 MW set can pass additional 45 tonnes per hr. of steam into the 32 kg. per sq. cm. system by controlled extraction when the demand exceeds the supply.

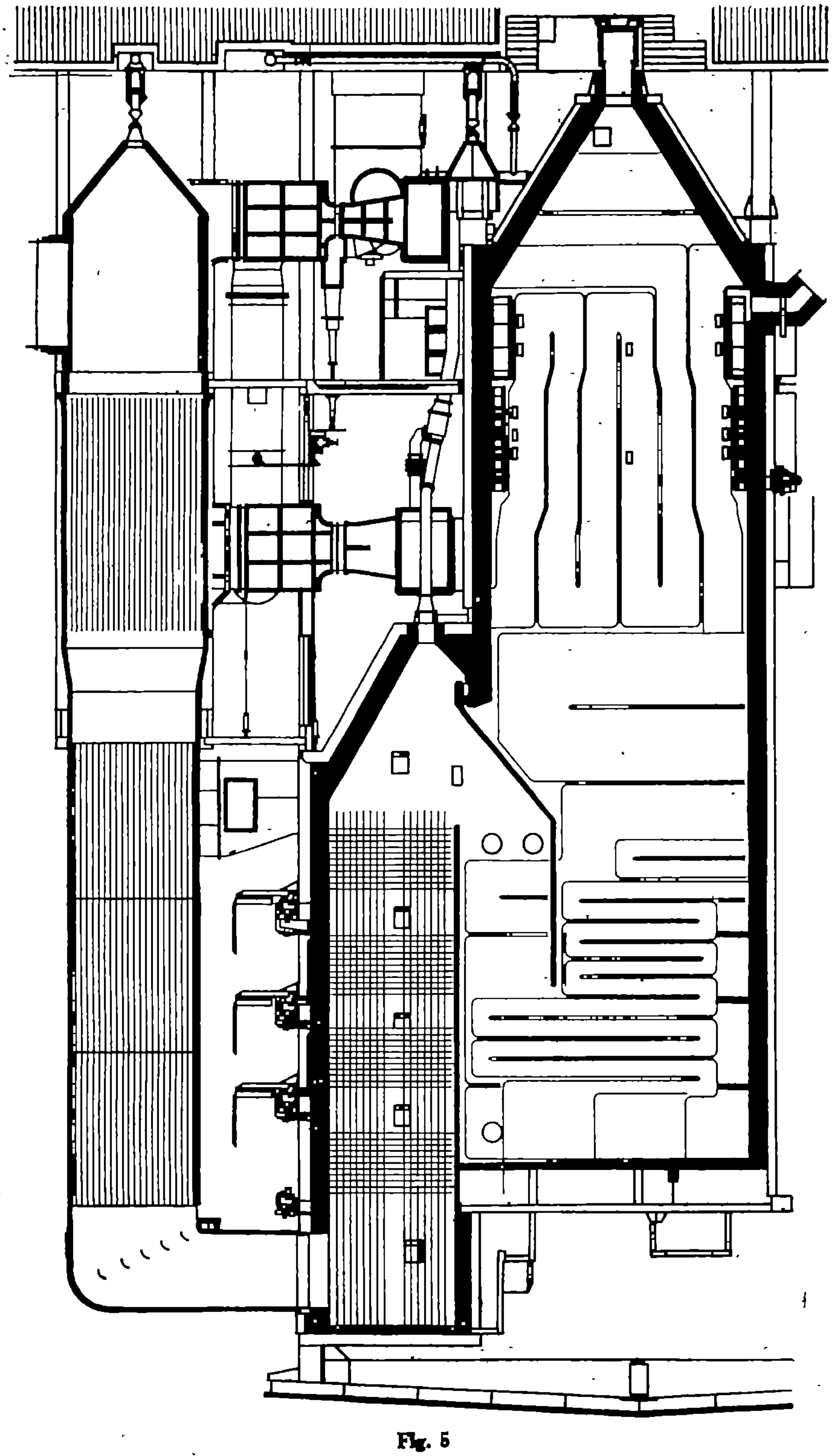

Fig. 5

Section through the boiler

Steam generators

Four identical Sulzer monotube steam generators have been installed in the station (Fig. 5) with provision for installing another boiler at a later date. Either blast furnace gas or pulverized coal can be fired in all the boilers. In boiler 1, the gas burners have been modified to allow firing of coke oven gas as well as blast furnace gas. But, this modification is of a temporary nature, since in future all the boilers will be equipped with supplementary coke oven gas burners to permit small quantities of this fuel to be burnt when available.

The operating data of the boilers are as follows :

Item	Coal	Furnace gas
Maximum continuous rating, tonnes per hr.	125	125
Pressure at superheater outlet, kg. per sq. cm.	95	95
Temperature at superheater outlet, °C.	520	520
Feedwater temperature, °C.	200	200
Air temperature after preheater, °C.	240	280
Blast furnace gas temperature after preheater, °C.	—	140
Outgoing flue gas temperature, °C.	150	150
CO_2 content in combustion chamber, %	15	20
Guaranteed boiler efficiency, %	87	89

The boiler design is based on fuels of the following composition :

Coal	
Net calorific value, kcal per kg.	.. 5,000
Volatile costituents, %	.. 38
Moisture, %	.. 5
Ash, %	.. 15
Grindability, hardgrove	.. less than 55
Blast furnace gas	
Net calorific value, kcal per Nm^3	.. 950
CO content, %	.. 28
H_2 content, %	.. 4
CO_2 content, %	.. 8
N_2 content, %	.. 60
H_2O content, %	.. 0

Since the different behaviours of these fuels exercise considerable influence on the working of the boilers (the question of whether they are fired alone or mixed being of major importance), careful preliminary studies were made to ensure correct boiler design and suitable disposition of the burners. To enable a boiler to operate at maximum rating on blast furnace gas alone, a combustion chamber of large

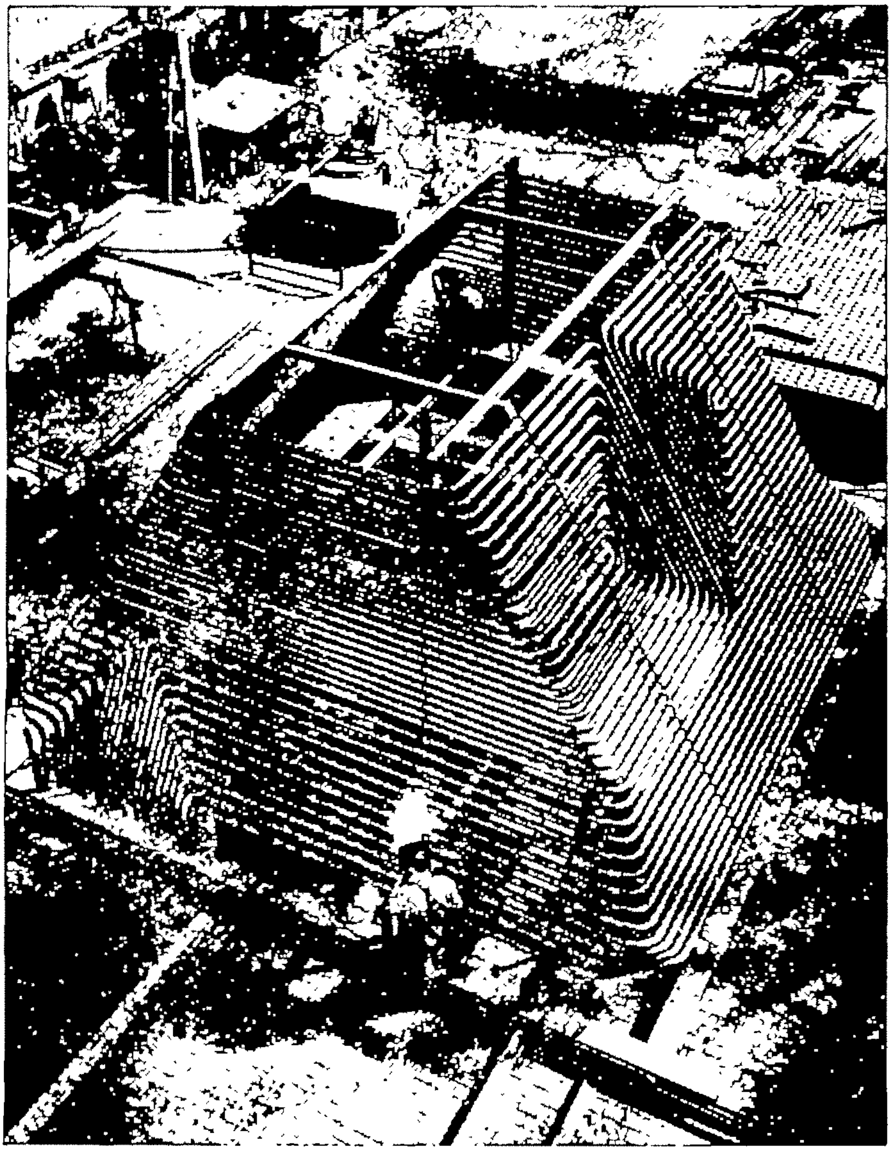

Fig. 6

Combustion chamber hopper

dimensions has been provided, and its walls are suitably shielded with tubes. A constant steam temperature of 520°C. was obtained with both fuels by placing the blast furnace gas burners below the coal burners. The dimensions and location of the evaporator and superheater heating surfaces were also selected with great care.

For coal firing, tangential burners with pulverizing mills have been provided, with flue gas extraction and direct fuel injection. The blast furnace gas is fired by fixed tangential burners. Ignition burners operating on light or heavy fuel oil are used for starting the boilers. At present, the possibility of firing small quantities of anthracene oil, a by-product of coke production, is being examined.

Fig. 5 illustrates the layout of the boilers. The monotube steam generator operates as described below.

The feedwater first enters the four banks of the economizer, from where it flows through the tubes of the baffle walls bounding the downtake flue and through the boiler roof to the combustion chamber hopper (Fig. 6) and the evaporator. The separator which follows eliminates the residual water, including the small quantity of salts contained in the feedwater. This blowdown amounting to 1 to 2% of the steam output is led to special evaporators serving for the preparation of the makeup water. The dry steam emerging from the separator flows through four descending platens, a mixing section with injection and five ascending platens. These platens form the first superheater. The intermediate spray valve keeps the steam temperature at the superheater outlet at a constant level. A connecting pipe with a second spray valve for regulating the final temperature joins the platen heating surfaces to the final superheater. This is formed by the tube lining on the combustion chamber walls above the evaporator and on the side walls of the downtake flue (Fig. 7). Both the combustion chamber and the flues are fitted with soot blowers.

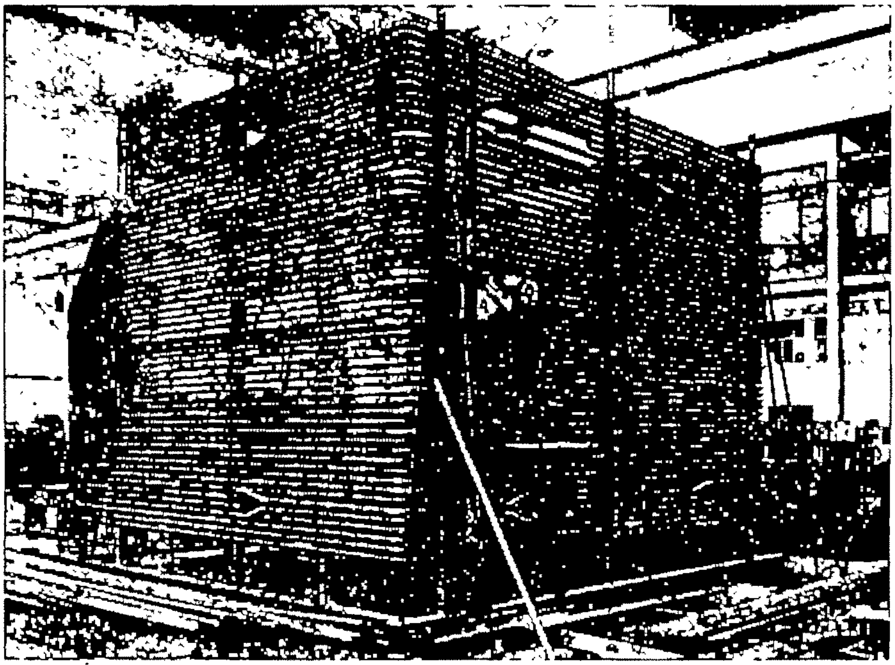

Fig. 7

Final superheater serving as wall lining

Combustion air is preheated by the flue gas in a tubular unit. When the boiler is operating on coal to give 125 tonnes per hr. of steam, the flue gas tmperature at the

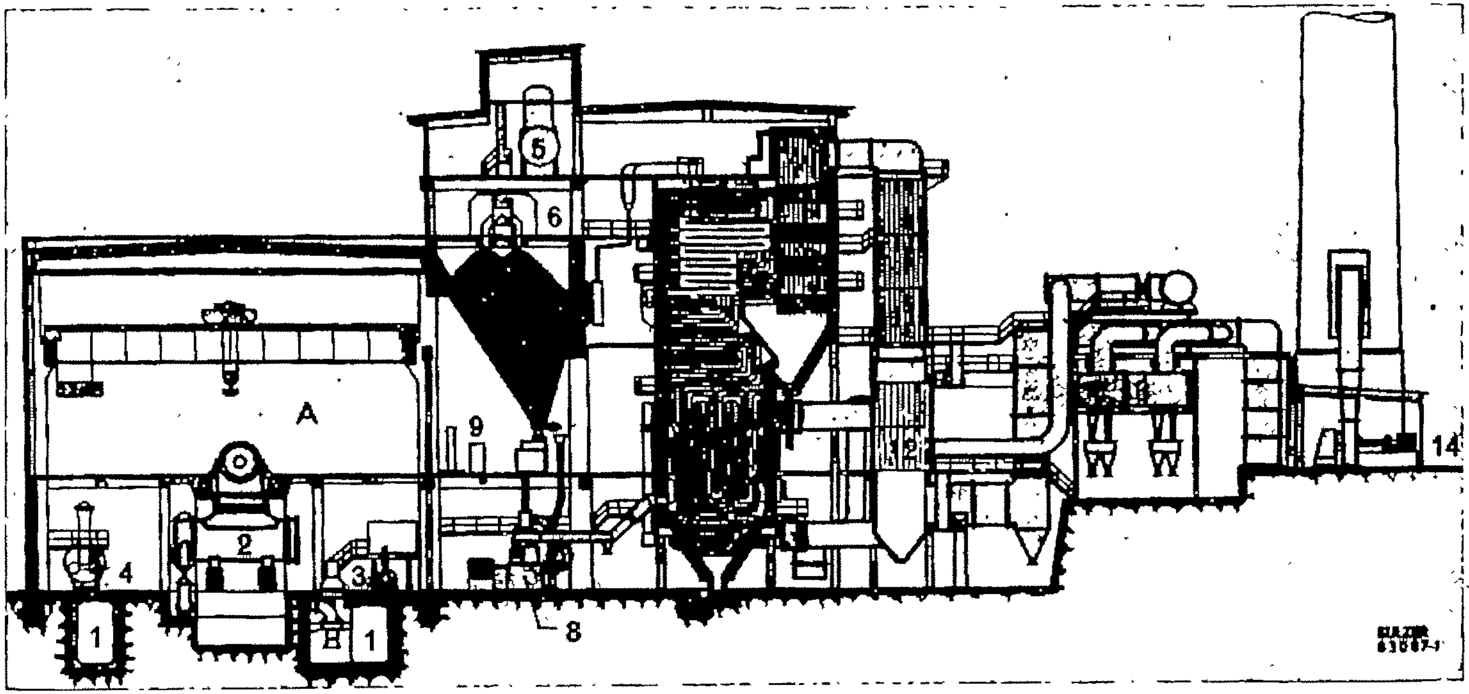

Fig. 8

Section through the power plant

A, machine hall ; 1, channel conveying sea water for cooling ; 2, condenser ; 3, feed pump ; 4, evaporator for preparing makeup water ; 5, feedwater tank ; 6, coal conveyor belt ; 7, coal bunker ; 8, pulverizing mill ; 9, boiler control station ; 10, boiler ; 11, air heater ; 12, blast furnace gas heaters ; 13, dust separator ; 14, induced draught fan preheater outlet is 150°C. With blast furnace gas firing, it is 202°C., and a preheater is then used to reduce the flue gas temperature to 150°C.

The design of the boilers and the boiler house diverge substantially from the conventional designs. The rear wall of the boilers also forms the outside wall of the boiler house so that the air and gas heaters are in the open air. The boiler framework is built into this outside wall and supports the boiler house roof. On the opposite side, the roof is carried by the concrete structure of the coal bunkers. The boiler framing has been designed to withstand the wind forces on the sides of the building (Fig. 8).

Each boiler has two motor driven feed pumps, either of which is capable of delivering the full quantity required, *i.e.*, 145 tonnes per hr. at 150 kg. per sq. cm. (Fig. 9). The unit which is normally in operation is equipped with hydraulic transmission, permitting stepless speed regulation. The other unit is without speed regulation and serves as a standby, starting up automatically in the event of main feed pump failure.

Each boiler has two forced and induced draught fans driven by squirrel cage induction motors through Voith hydraulic gears for stepless speed adjustment.

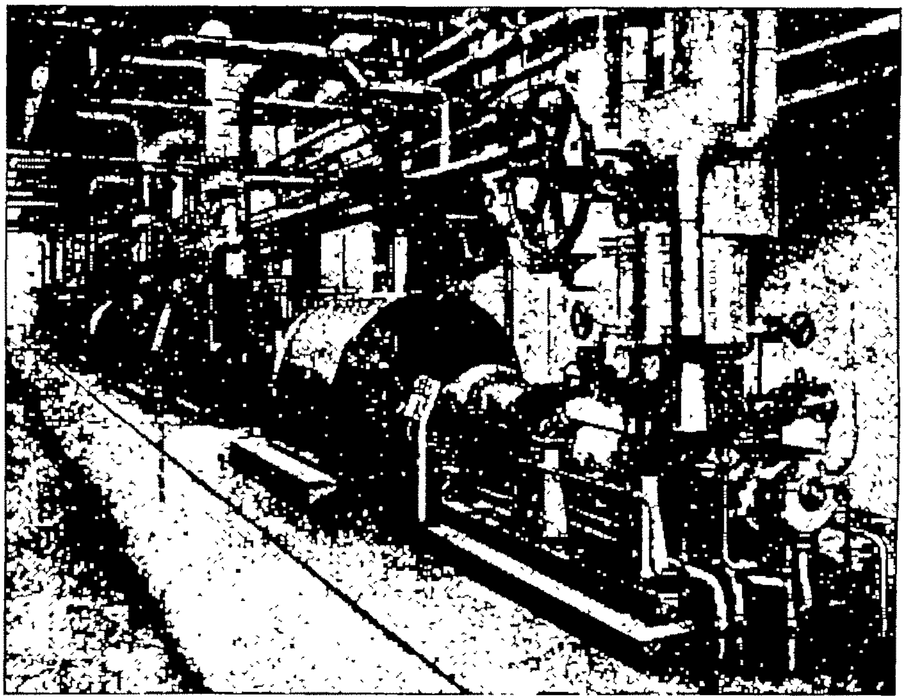

Fig. 9

Feed pumps

The control panels for the boiler blocks are located on the firing floors between the coal bunkers of boilers 1 and 2 and boilers 3 and 4, respectively. The machine hall is separated from the coal bunker bay by a continuous wall. On the other side of the coal bunker bay is the boiler house, followed by the outdoor air and gas heaters, the dust separators (four cyclones per boiler), the induced draught fans and the stacks (Fig. 8). Ash is removed hydraulically and is used to fill a depression about 2 km. from the plant.

Water treatment

Raw water is treated in two different ways according to its later use. Water for the steam transformers is passed through a plant consisting of a flocculation and decarbonizing tank followed by filters, base exchanger and a feedwater tank with de-aerator. The feedwater for the evaporators passes through a flocculation and decarbonizing tank followed by filters, but is then passed through a cation and anion exchanger with a CO_2 scrubber placed between them, after which it is made ready for further use in a feedwater tank with a de-aerator. Addition of small quantities of ammonia upstream of the evaporators enables a pH value of 9 to be maintained in the condensate.

Salt content of the treated water and the circulating condensate is checked at several points of the cycle by electrical conductivity measurements. Since the condensers are cooled by sea water, ingress of salts can thus be detected in good time and the part of the affected system can be isolated before the salt water can come into contact with other parts of the plant.

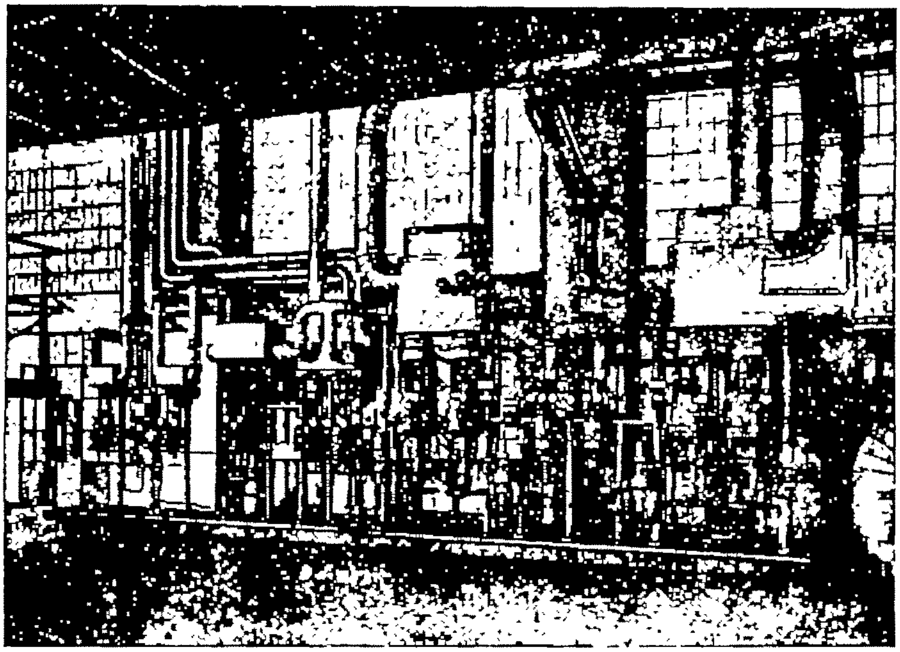

Fig. 10

Internal boiler control station

Boiler control

Automatic regulation of feedwater flow by adjustment of the speed of the main feed pump or by throttling when the reserve pump is in use, regulation of the final steam temperature by two spray points, and regulation of the steam pressure at the superheater outlet are main features of the boiler control system (Fig. 10).

Plant control

The following equipment have been provided for the control of the plant:

- (i) Pressure and temperature controllers (32 kg. per sq. cm, 400°C.) for the two pressure reducing stations, each handling 50 tonnes of steam per hr.;
- (ii) Pressure controllers for the feedwater tanks of 60 m.^{3} capacity each, consisting of a system of charging valves for steam at 32 kg. per sq. cm. and discharge valves to the condensers;
- (iii) Water level regulators for the feedwater tanks; and
- (iv) Control device for dividing the condensate between the feedwater tanks.

Combustion control

The steam generators are equipped with combustion control systems. The 30 MW set of block 1, which has to take the load variations of the 7.5 MW set,

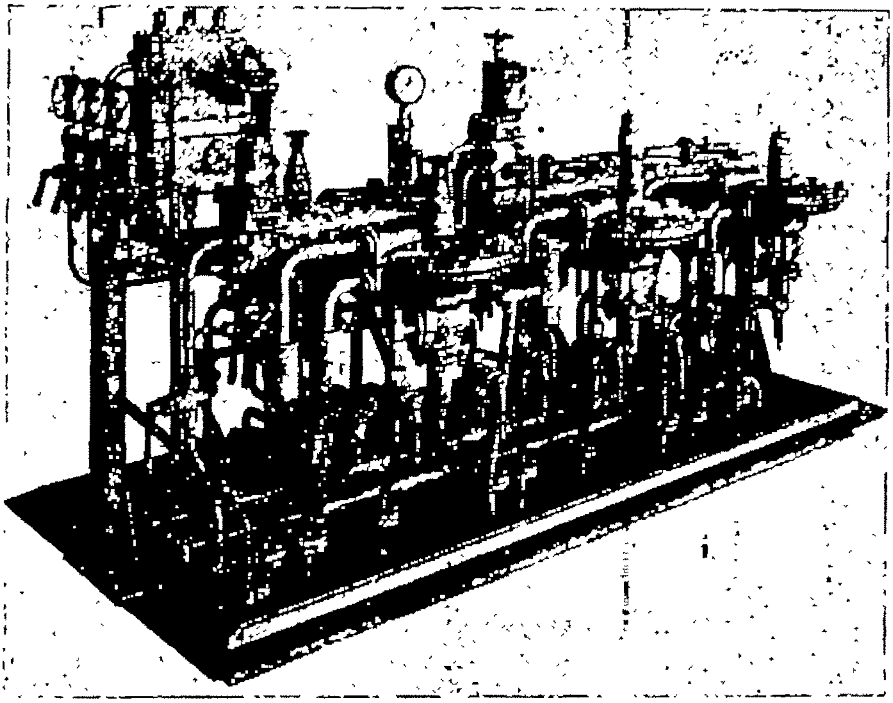

Fig. 11

Semi-automatic combustion control station

blowers and steam transformers, is controlled with the help of admission pressure regulators. The load on boilers 1 and 2 is adjusted manually through the thermal control panel by varying the feed rate of coal or blast furnace gas, as the case may be. The air supply and boiler draught are adjusted automatically (Fig. 11).

The 60 MW set in block 2 is operated with the help of a frequency controller, boilers 3 and 4 taking the load variations (Fig. 12). Here again, the coal supply is controlled from the switchboard by adjusting the speed of the feeders. When blast furnace gas is being fired, its feed rate is regulated automatically by a proportional integral controller employing volume and pressure signals. Corresponding air supply and boiler draught are set automatically by speed adjustment of the forced and induced draught fans. Since the quantity of blast furnace gas produced is subject to certain fluctuations, more or less coal is allocated to the boilers according to the level in the gasometer. Remote indicators are mounted in the boiler control panels to indicate the gasometer level.

Extension of the plant

As it is intended to double the production capacity of the steelworks, space is reserved in the machine and bunker bays for another 7.5 MW back pressure reducing station. With its output of 125 tonnes per hr., boiler 3 will provide steam for the new back pressure turbine and for driving two blowers. Blower 3 will serve as a standby for the other four units (Fig. 4).

Operating experience

After all due preparations had been made, including careful cleaning of the entire boiler system by repeated flushing, blowing out of boiler and steam piping, and adjustment of the control equipment, boiler 1 was put into operation on March 25, 1957. Table 1 shows the date of commissioning of each boiler together with their steam output, hours of service and outages due to the boilers up to the end of 1960. The utilization factor was obtained from the ratio of the actual to the maximum hours of operation possible. The boiler availability figures were calculated on the same basis. Table 2 gives similar data for the year 1960 only. It is seen that stoppages for overhauls of boilers 1 and 2 exceed the normal period of four weeks, the reason being that this work was carried out during periods of low power demand. The stoppages of other parts of the plant were caused mainly by the entry of salts and the resulting overhaul work on the sea water cooled condensers of the 60 MW set.

Boiler trials were carried out in June 1959 to check the performance of the boilers when burning mixed fuels at various loads. At the time of these tests, boilers 1 and 2 had already completed more than 15,000 and 10,000 hr. of service, respectively (Table 3). The efficiencies were determined by the indirect method, *i.e.*, by measuring the various losses separately.

Table 4 shows the composition of the types of coal burnt during these tests.

Although the coal fired had a higher ash content than on which the design of the boilers had been based, it gave satisfactory results with acceptable amount of unburnt materials in the ash.

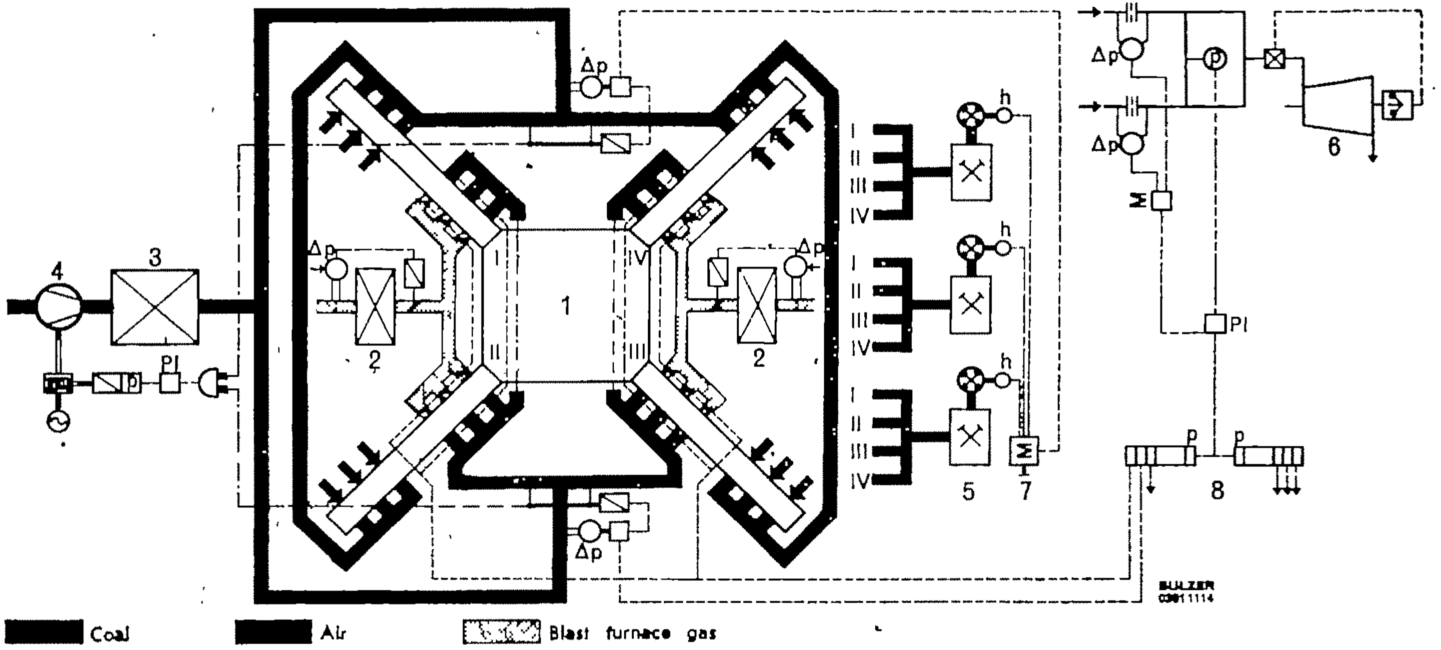

Fig. 12

Diagram of fully automatic combustion control system

1, combustion chamber ; 2, blast furnace gas heater ; 3, air heater ; 4, forced draught fan ; 5, pulverizing mill ; 6, 60 MW turbo-alternator ; 7, manual control for coal and combustion air ; 8, automatic control for blast furnace gas and combustion air

Table 1

Operating data of the boilers

Boiler no.	1	2	3	4
Date of commissioning	25.3.1957	25.9.1957	12.1.1959	1.2.1959
Total steam generated upto December 31, 1960, tonnes	2,276,327	2,295,925	1,107,930	893,835
Total hours of operation upto December 31, 1960	28,674	23,891	12,802	10,101
Mean boiler output from the date of commissioning to December 31, 1960, tonnes per hr.	79.4	96.1	86.5	88.5
Stoppages due to boilers from the date of commissioning to December 31, 1960, hr.	155	40	112	271
Boiler availability, %	99.5	99.8	99.3	98.4
Utilization factor, %	86.8	83.4	74.2	59.6

Table 2

Operating data of the boiler for the year 1960

Boiler no.	1		2		3		4	
Steam generated, tonnes	638,185		772,746		667,141		499,302	
Item	hr.	%	hr.	%	hr.	%	hr.	%
Hours of operation	7,580	86.3	7,470	85.0	7,205	82.0	5,068	57.7
Stoppages due to boilers	—	—	—	—	—	—	1	—
Stoppages due to other parts of the plant	—	—	3	—	191	2.2	125	1.5
Stoppages due to absence of demand	—	—	—	—	1,246	14.2	3,470	39.5
Stoppages for overhauls	1,021	11.6	1,179	13.4	38	0.4	46	0.5
Stoppages due to overhaul of other parts of the plant	183	2.1	132	1.6	109	1.2	74	0.8
Boiler availability	—	100.0	—	100.0	—	100.0	—	100.0
Utilization factor	—	86.3	—	85.0	—	82.0	—	57.7

Table 3
Results of boiler trials

Test no.	1	2	3	4	5	6	7	8
Boiler load, tonnes per hr.	122.5	40	101	41.8	115.5	94.1	124.9	40.8
Proportion of coal, %	72	—	50	—	—	—	43	11
Proportion of coke oven gas, %	28	100	50	—	—	—	—	—
Proportion of blast furnace gas, %	—	—	—	100	100	100	57	89
Net calorific value of coal, kcal per kg.	3,022	—	3,160	—	—	—	3,220	3,275
Net calorific value of coke oven gas, kcal per Nm^3	4,334	4,258	4,316	—	—	—	—	—
Net calorific value of blast furnace gas, kcal per Nm^3	—	—	—	842	855	848	856	851
Live steam temperature, °C.	521	523	522	512	525	521	521	508
Combustion air temperature, °C.	250	216	239	235	309	289	260	230
Flue gas temperture after air heater, °C.	182	156	167	151	188	169	173	147
CO_2 content after air heater, %	14.0	7.4	11.3	22.8	25.9	25.6	18	20.2
Losses due to unburnt matter, %	1.59	—	1.3	—	—	—	2.66	0.95
Proportion ef unburnt matter in ash, %	1.6	—	2.0	—	—	—	4.99	6.95
Losses in stack, %	7.4	6.3	6.93	7.75	8.88	7.87	8.71	7.7
Losses through radiation, etc., %	0.76	2.10	0.92	1.90	0.80	1.13	0.75	2
Total losses, %	9.7	8.4	9.15	9.65	9.68	9	12.12	10.65
Boiler efficiency, %	90.3	91.6	90.85	90.35	90.32	91	87.88	89.35

Table 4

Composition of coal burnt during tests

Test no.	1	3	7	8
Water content, %	9	9.20	9.05	9.35
Ash content as percentage of dry coal, %	56.20	55.01	54	53.05
Volatile constituents as percentage of dry coal, %	17.2	17.95	18.01	18.2
Fixed carbon as percentage of dry coal, %	25.6	27.54	27.99	28.75
Net calorific value of raw coal, kcal per kg.	3,052	3,192	3,174	3,221

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Assam Centre

Chairman's address by Shri K. Barua, B.E., M.C.P., M.I.E., at the 3rd Annual General Meeting of the Centre on January 20, 1962

The Chairman welcomed the Chief Guest, Shri S. N. Sharma, Revenue Minister, Assam, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

Delivering his address, Shri Barua outlined the history and development of the Institution since its inception in 1920, and briefly explained its technical activities. He also described the progress made by the Assam Centre. Speaking on the road problems in India, he said, 'It is well known that proper development of a country is not possible without a network of well planned roads. The Prime Minister once stated in this connection, 'I have come to the conclusion that one thing to which we must give topmost priority is roads, roads of all kinds, not only very up-to-date bituminous or cement roads but roads of any kind to open vast areas of this country, which are closed today and which we cannot reach unless we walk or ride. I give roads first priority'.

At the Chief Engineers' Conference at Nagpur in 1943, a 'star and grid' formula was evolved for road development. It laid down certain road mileages for various

States, based on the considerations of area, population, etc. According to the formula, Assam's requirements of motorable roads, including the national highways, are 13,200 miles. With the completion of the schemes taken up during the Second Plan period, road mileage reached a figure of 8,000 miles only. But, according to the report of the chief engineers on the 20-Years Road Development Plan for India for the period 1961-1981, the State should have 22,000 miles of motorable roads by the end of 1981. This means construction of about 3,250 miles of roads in each of the next four Plan periods. In view of the difficult financial position, it is proposed to construct only about 1,600 miles of motorable roads in the Third Plan period. In addition, it is proposed to metal and black top 274 miles of roads and upgrade nearly 500 miles of the existing low standard roads.

An all-weather road system requires provision of bridges across major rivers. It is proposed to undertake construction of five major bridges and reconstruct and strengthen 21,000 ft. of the existing weak and temporary bridges during the Third Plan, in addition to completing 13 major bridges which were started in the Second Plan. Besides, a road-cum-rail bridge over the River Brahmaputra at Pandu Amingaon is under construction. Envisaged completion of the road bridge over the Jia-Bhotali near Tezpur within the stipulated period, *i.e.*, by 1962, will allow through traffic on the North Trunk Road from north Gauhati to north Lakhimpur. This will remove a long felt bottleneck in road transport on the north bank of the Brahmaputra. Communication becomes difficult without bridges, but bridges are expensive and their construction is therefore postponed due to lack of finance. It is time that a comprehensive plan is drawn up for completing the bridges on the national and State highways at least by the end of the Fourth Plan.

In consequence of the all-round development of the country, traffic is increasing at a fast rate on roads which were neither designed nor constructed to cater for such traffic. The pavements are thus subjected to great stresses and strains. The meagre allocation for roads in the Third Plan does not premit sufficient funds for strengthening of the existing roads. Unless more funds are forthcoming to provide adequate road pavements, many sections of the roads will deterioiare to an extent beyond reasonable maintenances, eventually demanding heavy expenditure for their complete reconstruction.

The tempo of road development in the country has increased considerably since independence. Highway engineering has become a specialized branch of civil engineering. It is therefore important that departments exclusively in-charge of roads should be formed in each State to give undivided attention to all matters pertaining to roads.

While I advocate specialization in the field of highway engineering, I wish that some room is left in the undergraduate courses for studies in humanities. Lack of knowledge in practical subjects such as business administration, labour relations and industrial finance is common amongst engineers, though the success of an engineer often depends as much on competence in these fields as in engineering technology. Engineering colleges should, therefore, revise their syllabuses with a view to create a new pattern of study for engineering education in order to make engineers more competent in their profession.

While pleading for the development of road transport and asking for more vehicles on the roads, we should not overlook the serious problem of mounting road accidents and the resulting loss of human lives. Prosperity of a country leads to increase in traffic and in its wake, more accidents, but the number of accidents can be very much reduced through the services of traffic engineers specially trained to look into the adequacy of width, sight distance, gradients, curves and crossings of roads for proper regulation of traffic.

On a number of occasions, the President, the Vice-President, the Prime Minister and other leaders have stressed the pre-eminent role of the engineer and scientist in the context of the Five Year Plans. The President in his inaugural address to the Annual Convocation of the Central Board of Irrigation and Power in 1959, said, 'Your profession is indeed a noble calling. But at the same time, I agree with you that you must have conditions of service commensurate with the important role which you play in the country's life. I have, therefore, nothing but sympathy and support to offer in your efforts to a fair deal from the Government. I see no reason why technical personnel should not be treated at par with administrative personnel and technical services should not be given the same emoluments and advantages as the country's administrative services. I am sure sooner or later it is bound to happen as per Planning Commission and, more than anyone else, our Prime Minister have repeatedly supported this view.'

Considering the engineers' contribution to the country's struggle to. win the war against poverty and want, it is necessary that we should attract the best talent in the country to this profession. It should be borne in mind that the conditions in which a young engineer has to work should be such that he is contented and gets full facilities and proper scope for his development and growth so that he can contribute his best.

It is unfortunate that very often the engineer's role is not given due recognition. The Indian Service of Engineers has now died. The class I cadres of the States and the Centre show wide disparities in emoluments and conditions of service and have pay scales and status incomparably lower than the officers of the Indian Administrative Services.

It is heartening to note that in the Conference of Chief Ministers, presided over by the Prime Minister in August 1961, the proposal for revival of the All India Service of Engineers, along with some other services, has been accepted. Now we look forward to its early implementation.

Construction and maintenance of highways, which form the arteries of civilization, have a vital role to play in the overall life and economy of the country, and it is our privilege to serve the nation in their field.'

Poona Centre

Chairman's address by Brig. P. R. Kumar, M.E., M.I.E., at the 3rd Annual General Meeting of the Centre on January 14, 1962

The Chairman welcomed the Chief Guest, Shri D. S. Desai, Minister for Education, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

Delivering his address, Shri Kumar traced the history of engineering education in India and outlined the steps that can be taken to improve the standard of engineering education in the country in the following words.

Early history

'Ancient history does not throw much light on the existence of any institution for technical training. Occupational skill was handed down the generations through succession or on the master craftsman-apprentice basis. The system of apprenticeship was practised on an extensive scale. Initiative, skill and creative genius of apprentices stood in good stead. There was enough scope for experimentation and innovation, and in that way to improve the occupational skills. All occupations in the industrial activities required for temple building purposes were organized on the guild system. The discipline of the hard process of observation and experience was preserved in unbroken succession through centuries.

In the early days, there was no difference between the art and the craft. The artist was the craftsman. They were called *shilpis*, which was an all-embracing term covering artists, architects, sculptors and others associated with activities extending to sciences such as mathematics and astronomy. The practices and the rules of the *shilpis* date back to the beginning of the present Indian civilization, *i.e.*, about 3250 B.C.

In those days, architecture and engineering were synonymous. In ancient Indian works such as '*Manasara*', ten branches of Indian architecture and engineering are described.

Krishi shastra	Organic production
Jala shastra	Water conservancy
Khanija shastra	Inorganic production
Nowka shastra	Marine transport
Ratha shastra	Terrestrial transport
Vimana shastra	Aerial transport
Weshma shastra	Buildings
Prakara shastra	Fortification
Nagara rachana shastra	Town planning
Yantra shastra	Mechanical sciences

These branches involved 32 *vidyas* and 64 *kalas*.

References to these and many allied branches of engineering, labour laws, cooperative societies, municipal undertakings, agreements for work, etc. are available in ancient history. Such references are also available in the form of instructions to tradesmen. Architecture of styles pertaining to different religious, dynastic and other influences is also described in ancient literature. While the knowledge is available in books, there is no reference to teaching of engineering in a technical institution or as part of a course of study in any Indian university in existence in those days.

Even under the British regime, there was no technical institution for a very long time. Towards the end of the 17th century, the East India Company had Indian pioneers as part of their military establishment at Surat, Bombay, Masulipatam and Hooghli, for construction and repair of primitive defences and fortifications to guard their garrisons. In 1757, Robert Clive started organizing native troops into regular battalions, and need was felt for engineer soldiers to support them. Temporary companies of the European and Indian pioneers were raised for particular operations and were disbanded on the completion of these operations. A school for surveyors was established by the East India Company in 1754 in Madras, which was perhaps the most ancient engineering institution in India on Western lines.

Provincial engineering colleges

Next we come to the era of the three provincial engineering colleges at Madras, Roorkee and Poona. Long before the British regime started, India had undertaken a number of irrigation works. Some of these needed repairs. In the early 19th century, the Government began the restoration and improvement of the existing canals. To meet the growing requirements for trained engineers to be employed on these canals and other civil engineering works, engineering colleges were started at Guindy (Madras), Roorkee and Poona in 1842, 1846 and 1854, respectively.

The Guindy Engineering College was started as a school in 1842 and was affiliated to the University of Madras in 1858. In 1880, it developed into a civil engineering college with a three-year degree course and 2½-year subordinate course. Later, degree courses were introduced in civil and mechanical engineering branches. Electrical engineering was introduced in 1930, telecommunication in 1945, and highway engineering in 1946. Post-graduate courses were introduced in the early forties.

From its beginning in 1846, the Thomson College of Civil Engineering at Roorkee catered for the training of young Indian students and European non-commissioned officers. Later, specialized military courses were started for young officers, non-commissioned officers and privates of the Sappers and Miners at Roorkee. Civil, mechanical and electrical engineering classes were also conducted. From 1935 onwards, the college undertook the training of officers for the Corps of Engineers. The training of British non-commissioned officers and technicians, which had been discontinued, was re-started in 1941. The college also undertook the training of war technicians. In 1943, the School of Military Engineering was started at Roorkee, making full use of the facilities available at the Thomson College. The Thomson College later developed into the Roorkee University and the School of Military Engineering into the College of Military Engineering at Kirkee.

The College of Engineering, Poona, was started in 1854 as a school for providing instructions to subordinate officers in the Public Worke Department. Degree courses were introduced in 1866, and the college was affiliated to the University of Bombay. Overseer's course also continued alongside, and in 1879, the institution was redesignated as the College of Sciences with the inclusion of courses in agriculture, forestry and science. In 1899, forestry classes were discontinued. Agriculture classes were transferred to the College of Agriculture in 1907. Science courses were later transferred to the Royal Institute of Science in Bombay, and the college was redesignated as the College of Engineering. Later, degree courses in telecommunication and post-graduate courses were added to the curriculum.

Technical education in the early 20th century

Technical education in India during the early 20th century was mainly in the hands of the provincial governments without any coordination between the various institutions. The problem of integrated approach to the training of technical manpower was not made on an all-India basis till the end of the Second World War. Most of these institutions were turning out general purpose engineers required in those times. There was little idea of specialization, post-graduate or research work. The idea of separate institutions for diploma and degree courses was non-existent, and most of the existing institutions were conducting both degree and diploma courses simultaneously. As there were only a few industries at that time, the need for craftsman's courses for training of personnel for the industries was not visualized.

This period witnessed the following expansions in technical education, in addition to the provincial colleges.

(i) Banaras Hindu University started combined degree courses in electrical and mechanical engineering.

(ii) Indian Institute of Science, Bangalore, started diploma courses (equivalent to degree) in electrical engineering.

(iii) Mysore University Engineering College, Bangalore, started civil, electrical, and mechanical engineering degree courses.

(iv) Punjab Engineering College started civil engineering degree and diploma course.

(v) N. E. D. Engineering College was established at Karachi.

Another department contributing towards engineering education was the Railways. Though the officers for the Railways were either from foreign countries or from degree holders of engineering institutions in India, there were a number of schools for the subordinate personnel. During the First World War, the Railways trained technicians for the army also. During the early stages of the War, there was a War Branch of the Railway Board for recruiting and training of tradesmen, which was later changed to Munition Board. Later, the army started schools for training of signallers, assistant station master, drivers, mechanics, etc. The defence services were thus associated with the advancement of technical and engineering personnel for a long period. The oldest organized system of trades training has been in existence in the Sappers and Miners (now called the Corps of Engineers) for over a century, though it dealt with building trades only.

Engineering education between the First and Second World Wars

Between the First and Second World Wars there was very little growth in engineering education. In 1920, the Institution was constituted, and in 1936-37, a committee of experts from the U.K. visited the country and produced the Abbott-Wood Report on technical education. In the meantime, a few industrial centres developed gradually in different parts of the country, but there were no separate training schemes for their technical personnel. By 1939, however, the Consultative Committee of the English Board of Education went through this problem to a certain extent, and produced their report on technical high schools for feeding the industries. Before this could be implemented, the Second World War started.

Engineering education during the Second World War

The Second World War brought forward the necessity for large number of technical personnel and a technical training scheme was initiated. The locations of war industries were away from the industrial centres, and any expansion of these industries meant training of personnel before hand. Training of new men for all kinds of processes was regarded as important as producing a finished product. In technological education, some new activities during the Second World War were as given below.

(i) Under the war-time technical training scheme, about 10,000 engineering trade craftsmen were trained.

(ii) A part of the additional requirement of engineers and technicians was met by expansion of the intake capacity of the existing colleges and technical institutes and by opening new institutions.

(iii) New branches such as power engineering, high voltage engineering, internal combustion engineering, aeronautical engineering, and chemical engineering were started at the Indian Institute of Science, Bangalore, with facilities for post-graduate studies.

(iv) The combined electrical and mechanical engineering degree course at the Banaras Hindu University was abolished and separate degree courses in these branches were instituted.

(v) The Central Advisory Board of Education prepared their report on 'Post-War Educational Development in India' (Sargent Committee Report, 1944).

(vi) Under the aegis of the defence services, a training scheme was started for supply of tradesmen to the various ordnance and ammunition factories. By the end of 1942, about 380 training centres were in existence with a total capacity of over 60,000 apprentices.

Technological developments in the post-war period

The Second World War ended with atomic bomb. The problem of harnessing the energy of atomic fission and fusion for peaceful purposes came up immediately afterwards. There were a number of other developments in chemical and industrial engineering due to the introduction of plastics and other new materials. Rocketry, which has now put man in flight round the earth, also came to the fore. Science, technology and engineering were advancing so rapidly that we could not depend on foreign countries for our technical manpower requirements. Our independence also contributed to this situation.

Immediately after the war, the technical training facilities were utilized for rehabilitation and resettlement of ex-servicemen and for training of civilian personnel. In 1948, the Central Training Institute was established at Bilaspur, and was later shifted to Calcutta. As a long term measure to ensure adequate supply of technical personnel, the All-India Council for Technical Education was constituted to advise the Government on the development of technical education above the high school level. The recommendations of the Council included the establishment of four higher technological institutes and upgrading and re-orientation of about 13 existing engineering colleges for post-graduate work. The first of these higher technological institutes was set up at Kharagpur in 1950.

Another step in this direction was the formation of the Association of Principals of Technical Institutions for formulating a national policy for technical education and for establishing all-India standards of education. The University Grants Commission and the Scientific Manpower Committee also came into being during this period.

First Five Year Plan

During the First Plan, the financial allocation for engineering education was of the order of Rs. 23 crores. There was rapid growth in technical education during this period as detailed below.

(i) The number of institutions offering degree courses in technological subjects increased from 38 in 1947 to 68 in 1956, and those offering diploma courses from 53 to 107 during the same interval. Admissions to the degree courses increased from 2,940 in 1947 to 5,864 in 1956, and diploma courses from 3,670 to 9,988. The degree courses included civil, electrical, mechanical, chemical, metallurgical, agricultural, marine, aeronautical, telecommunication, and mining engineering.

(ii) The facilities for research and advanced studies were further extended at the Indian Institute of Science, Bangalore.

(iii) Thirteen existing engineering colleges were upgraded to facilitate post-graduate instruction and research.

(iv) A network of national laboratories to undertake industrial and fundamental research was established.

(v) The Council of Scientific and Industrial Research sponsored a number of research schemes in different engineering colleges and institutes.

(vi) To meet the requirement for craftsmen, about 59 industrial training institutes were founded with a total capacity of 10,500.

Second Five Year Plan

During the Second Plan period, the total outlay on technical education was of the order of Rs. 60 crores. During this period, the following activities in the field of engineering education took place.

(i) Ninteen engineering colleges and 46 polytechnics were selected for expansion in preference to the establishment of new institutions, thus providing 2,538 additional seats in the degree colleges, 4,225 in diploma institutions, and post-graduate capacity of 1,000 was attained.

(ii) Three higher technological institutes at Bombay, Madras and Kanpur were established.

(iii) Ten regional engineering colleges, distributed all over the country, were set up.

(iv) Engineering universities at Roorkee and Jadavpur came into being.

(v) The number of colleges increased from 68 to 87 and polytechnics from 107 to 193.

(vi) The Council of Scientific and Industrial Research sponsored more research schemes.

(vii) Aid under the Colombo Plan, Technical Cooperation Mission and the Unesco were made available to engineering institutions to enable them to expand the facilities for advanced studies and research.

(viii) Technical Cooperation Mission Teachers Exchange Scheme was started.

(ix) Industrial training institutes for craftsmen were increased to 167 in number, with a total capacity of 42,000.

(x) The National Apprentice Training Scheme, the counterpart of the Craft Apprentice Training Scheme for Workers was started during this period and provided for training of 2,691 apprentices.

Third Five Year Plan

The financial outlay in the Third Plan for technological education is Rs. 176 crores.

Requirements of engineering personnel in the Third Plan are 45,000 graduates and 80,000 diploma holders, and 50% expansion in the existing facilities is contemplated to meet these requirements. Annual intake of degree students is proposed to be increased to 19,500, and 26 colleges and 94 polytechnics are to be set up in addition to considerable expansion of facilities in the existing institutions. New institutions to be started are (i) nine regional engineering colleges and 27 polytechnics by the Central Government, (ii) eight colleges and 47 polytechnics by the States, and (iii) nine colleges and 20 polytechnics in the private sector.

Besides these, the National Aerodynamic Laboratory at Bangalore has already started functioning.

Recently, the Defence Ministry has taken cognizance of the existing shortage of trained personnel and the need for providing facilities to serving personnel for bettering their technical education and standard. A scheme has been started in which training is organized and instruction imparted with a view to helping them to pass Sections A and B of the Associate Membership Examination of the Institution.

It is contemplated to set up 150 industrial training institutes, thus raising their total number to 318, and the intake capacity for training of craftsmen in engineering and non-engineering trades to 100,000. Under the National Apprenticeship Scheme, the intake capacity is proposed to be increased to 12,000 during this period. Three more trainee instructor training centres are proposed to be set up at Madras, Hyderabad and Ludhiana.

Lacunae

The planning of the Third Plan has crystallized our ideas about the scope of activities for engineers and technologists. Our requirements for technical manpower are phenomenal. The planners of technical education should see that adequate number of the different categories of technical personnel are produced at the right time and training is imparted in the type of specialities required. Although there are Government departments to solve these problems, some of these which do not seem to have been fully and properly tackled are :

(i) coordination between the higher technical institutes and regional, State and private engineering colleges ;

(ii) coordination between research facilities available in the different teaching and research institutes,

(iii) rationalization of courses in the higher technological institutes which, being financed by different foreign countries, tend to a certain extent to reproduce the technical facilities of those countries as opposed to the facilities necessary to meet the special requirements of our country ;

(iv) over-production of technologists in certain categories and under-production in others ;

(v) very narrow scope for specialization, thus creating unemployment for some with very high qualifications ;

(vi) exodus of well qualified teaching staff from small institutions to regional colleges and institutes for better prospects ; and

(vii) training of teachers for technical colleges and institutes.

Coordination between the technical institutes, colleges and research institutes, and rationalization of the courses of study have to be planned on an all-India basis to meet the requirements of engineering activities in the different regions. There is such an organization at Delhi but the results are not satisfactory, and detailed planning is still necessary.

A solution to overcome the shortage of a particular category of technologists in a particular region might be to set up colleges dealing with the speciality.

With regard to narrow specialization, we should not produce high grade specialists and throw them in the open market without adequate employment opportunities, either in quantity or quality.

In regard to the higher technological institutes drawing the best technical teachers in the country, it is necessary but it should not be at the expense of other institutions, Other teaching institutions also require men of quality. One of the methods of ensuring this is to equalize the pay scales for teaching staff irrespective of the institution served, or narrowing down the gap between the pay scales. Another solution to overcome this difficulty of technical teachers gravitating to the institutions offering better salaries and to solve the acute problem of the heavy shortfall in the right type of teaching personnel, is to have a regular technical teachers training programme and to produce teachers in large numbers.

Training of technical teachers

There is an acute shortage of teaching personnel and our training schemes have suffered to a large extent on this account, thus throwing back the programme of planned projects. We have to produce the right type of teachers in adequate numbers. Increasing of pay scales has been suggested but has not been implemented so far. Increase of pay scales may stop the teachers from gravitating to the institution offering higher pay scales, but will not overcome the shortfall in the number of technical teaching personnel.

A method to overcome the situation is to create a central pool of teachers with attractive terms of service comparable to Government services, industries, etc., and at the same time to create sufficient facilities to train engineers with the right aptitude and attitude to be effective technical teachers in large numbers.

The earliest steps taken for training of teachers included exchange of teaching personnel under the Technical Cooperation Mission, Unesco, and the Colombo Plan. These cater for very small numbers and have been of very limited use. They also tend to be a one-way traffic as foreign teachers made available to this country are not always of the right type while our teachers are sent to foreign countries for advanced courses, and not necessarily for gaining experience in teaching.

Of more recent origin is the decision of the Council of Scientific and Industrial Research to select some centres for training of teachers in different branches of engineering. The centres selected so far are the Indian Institute of Technology Kharagpur, the University of Roorkee, and the engineering colleges at Poona, Guindy and Bangalore.

Conclusions

Engineering knowledge and craftsmanship were available in India from the very ancient times.

Engineering education on modern lines was unknown in India until the latter half of the 18th century. After that there has been a steady growth in the number of engineering colleges and schools, which was slow until the outbreak of the Second World War, but very rapid after that. The Railways and the defence services have contributed greatly towards the training of technical manpower.

With the Five Year Plans, there has been a planned growth of engineering education also, but there seem to be certain drawbacks. There is an acute necessity for coordination and guidance from the top. There must also be a method by which the engineering institutions could be provided with the right type of staff to the requisite extent.

Summaries of Papers Published in the Journal, vol. 42, no. 9, pts. CI 5, ME 5 & ET 3, May 1962

CIVIL ENGINEERING DIVISION

Determination of the Elements of Hydraulic Jump in Trapezoidal Channels

R. M. Advani

Member

An attempt has been made in this paper to discuss the various methods of determining the elements of hydraulic jump in trapezoidal channels. Also, a simple method of universal application, devised by the author and based on the use of relative numbers coupled with sound dimensional reasoning, has been presented and its importance outlined.

Seawalls And Breakwaters

Dr. M. Manohar

Member

The design of seawalls and breakwaters is still far from perfection. There are many theories and empirical formulae for their design but each has its own advantages and disadvantages. In the last 20 years, on the basis of field observations and numerous model experiments, design analysis on sound and more reasonable theoretical basis has been made, and the author has, in this paper, after a thorough analysis, described the best design criterion which may be adopted under different conditions.

A Review of Flow in Pipes

B. Mohanrao

Non-member

This paper describes the analytical investigations of Prandtl and Karman and the experimental work of Nikuradse which have led to the 'universal laws of resistance' for turbulent flow in smooth and rough pipes. The 'transition law' of Colebrook and White and the new concept of flow in rough pipes advanced by Morris are also elucidated.

Progressive Masking of the Bhagirathi

D. Mookerjea

Member

This paper presents an analysis of the gauge readings taken on the River Bhagirathi at Berhampore since the year 1900, with a view to examine whether there is a positive declining trend in the quantity of the flow coming from the River Ganges, resulting in deterioration of the navigable approaches to the port of calcutta.

Bamboo Concrete Composite Construction

S. K. Narayana
Associate Member
and
P. M. Abdul Rahman
Student

Attempts in the past to use bamboo as an embedded reinforcement in concrete were not completely successful on account of the undependable bond between the two materials. Bamboo embedded in wet concrete absorbs water and swells; later, it gives up water and shrinks, with the result that the bond between the materials is destroyed. The new method deviced at the Central Building Research Institute, Roorkee, uses bamboo as an external reinforcement; the load transfer from the concrete to the bamboo taking place through shear connectors. The object of the experiments reported in this paper was to compare the relative efficiency of seven different designs of connectors. Slabs incorporating these were tested to destruction. The results show that the integral connectors formed by cutting notches in the bamboo at intervals are the most efficient.

An Investigation of the Mould Size Effect on the Compressive Strength of Soil Cement Mixes

S. Nazir Ahmad
Non-member

This paper deals briefly with the effect on the compressive strength due to variation in the size of a cylindrical soil cement specimen. The investigation compares the strengths obtained in the cylindrical specimen of two recommended sizes for fine and medium grained soils conforming to B.S.: 1924-57. The strengths obtained both for 7 days and 28 days curing are compared for 4 in. × 2 in. and 8 in. × 4 in. specimens made of the same density and at the same moisture content under identical conditions. The paper first reviews some previous work done on concrete on these lines and then describes the author's study with results and conclusion.

Influence Line for Horizontal Thrust in Two-Hinged and Fixed Portals by Relaxation Method

Prakash Desayi
Graduate

Fixed portals are generally classified among the structures called 'rigid frames.' An example of this is the rigid frame bridge intended to carry the traffic of a highway or railway. Economy along with the possibility of giving an attractive appearance by suitable variation of section, has resulted in its being largely adopted. After the preliminary design is made, analysis of these frames by the orthodox method is not simple as the section of the portal varies in almost all cases (as they are mostly of reinforced concrete) and usually involves model study. Though model study has the advantage of giving all the necessary quantities such as influence lines for moments, horizontal thrusts, etc., its disadvantages lie in the time consumed and the trouble involved in the preparation of an accurate model. This paper presents simple numerical methods based on the relaxation principle for finding the influence line for horizontal thrust in portals.

Hydraulic Analysis of Pipeline Networks by Direct Electrical Analogy Method

V. Raman

Non-member

A small experimental electrical analyzer was set up, based on complete analogies existing between hydraulic and electrical characteristics, for analyzing flows and pressures in a pipeline network consisting of 12 pipes, one put-in and three take-offs by using small commercial lamp bulbs and vacuum tubes. Analogies between hydraulic and electrical characteristics are briefly mentioned. Experimental procedure for the selection of suitable bulbs and the sequence of steps involved in the setting up of the electrical analyzer are described.

PUBLIC HEALTH ENGINEERING GROUP

Economic Aspect of a Sewage Disposal Plant

Dr. Ing. Shamim Ahmad

Non-member

During the last decade, much has been done to improve the sanitary conditions of the cities, towns and villages almost all over the world. It has been realized that the provisions and improvement of the sanitary requirements is no more a luxury but a necessity. Whenever any project for sanitation is taken up, people ask about the cost. Therefore, it is necessary to study the cost of the sewage treatment plants and to design them to be most economical and fitting to the situation. An attempt is made in this paper to give a scientific approach to this problem.

ROADS & ROAD TRANSPORTATION GROUP

Subgrade Theories in Design of Concrete Pavements

N. K. Vaswani

Associate Member

Theories in design of concrete pavements so far advocated are (i) static load theory, and (ii) dynamic load theory. The static load theory is again divided into (a) liquid subgrade theory, and (b) elastic solid subgrade theory. These theories are based on certain assumptions which are common to all of them. For each theory, the effects of these assumptions on the design of concrete pavements are discussed in this paper.

Since the soil cannot be treated as a thick liquid, the revision of the liquid subgrade theory based on laboratory and field investigations is pointed out. This revised theory accounts for stresses due to other causes in addition to load application. The scope and application of the elastic solid subgrade theory and dynamic load theory have also been discussed.

As a result of these discussions, the conclusion arrived at is that the Westergaard's modified subgrade theory can be adopted for design of concrete pavements, while elastic subgrade theory can be applied for interior loads only, and the dynamic load theory requires further investigations before it can be suitably applied.

MECHANICAL ENGINEERING DIVISION

Behaviour of the Power Screw Assembly of a Machine Tool Under Rolling as well as Sliding Friction

S. K. Basu
Associate Member

In this paper, friction losses of a ball recirculating power screw assembly are compared with that of ordinary trapezoidal screw assembly having sliding friction, and a method of accurately calculating the efficiency of the sliding screw assembly under lubrication is suggested.

The efficiency of the ball recirculating screw assembly exceeds 90% except at low speeds where it is slightly less. This may be due to (i) tendency towards sliding, and (ii) friction loss in the returning tube or canal through which the balls are recirculated. The average value of the coefficient of rolling friction obtained from results of the experiments is 0.001 cm. The efficiency and the coefficient of friction of a ball recirculating screw assembly are not dependent on the viscosity of the oil. The coefficient of friction of the sliding screw assembly increases with (i) increase in the viscosity of oil, (ii) increase in the velocity of sliding, and (iii) decrease in the amount of axial loading. This is mainly due to large 'constant loss' or loss due to viscous friction. Based on correlation of the experimental data, a systematic procedure for calculating the efficiency of the sliding screw-nut assembly, *i.e.*, assembly working in sliding friction, is given.

Mobility Technique to Study the Oscillatory Behaviour of Some Isolation Systems

K. N. Gupta
Non-member

In this paper, adoption of mobility technique is proposed as a method to predict the response of isolation systems to simple harmonic forces. Force transmissibility expressions are derived for some isolation systems with single degree of freedom, and a comparative study is made. It is concluded that a damper in series with a spring represents an ideal scheme for vibration isolation, but it cannot support any dead load. A slight modification in the classical isolator enables most effective isolation of high frequency vibration.

Some Planning and Constructional Aspects of the Continuous Merchant Bar and Rod Mill of the Indian Iron and Steel Co., Ltd., Burnpur

P. K. Singha Roy
Graduate

This paper deals with the civil engineering aspects of planning and construction of the new continuous bar and rod mill of the Indian Iron and Steel Co., Ltd., Bunpur. A brief description of the rolling and re-rolling process is followed by a description of the mill components such as the furnace, the mill stands and their drives. The construction of the mill involved excavation of about 3,000,000 c.ft. of earth, pouring of about 1,000,000 c.ft. of earth, and erection of about 9,000 tons of structural steel. The methods used for carrying out these works are described with particular reference to the furnace, basement structure, the flue, and the mill structure.

ELECTRONICS & TELECOMMUNICATION ENGINEERING DIVISION

Variation in the Angle of Arrival of Radio Waves and Large Scale Ionospheric Irregularities

S. S. Banerjee
Non-member

and

P. K. Mukherjee
Non-member

Much work has been done to account for the variations in the angle of arrival of radio waves by Appleton and Barnett, Smith Rose and Barfield, Hallingworth, Wilkin, Frus and many others. It has been observed that slow random variations in the angle of arrival of downcoming radio waves are due to tilts in the lower surface of the ionosphere and the periodic variations can be interpreted as the result of large scale ionospheric irregularities or undulations in the ionosphere which give rise to drift velocity in these regions. Various parameters of the undulations and the drift velocity have been calculated from the periodic variations in the angle of arrival. Some years ago, observations on this angle were also started in the Engineering College Laboratory, Banaras, in connection with the intensity variation of received radio signals, and the anomaly in the variation was explained by taking into account the magneto-ionic interference of the coming waves. This paper explains the variation in the angle of arrival of radio waves by means of two spaced aerials, and the method of calculating the parameters of the irregularities in the ionosphere from periodic observations.

A Multiloop Feedback Amplifier for Improved Performance

Dr. A. K. Chatterjee
Member
and
J. G. Advani
Non-member

Negative feedback is widely used to desensitize the overall gain of feedback amplifiers due to variations in forward gain circuit parameters. There is, however, a consequent loss of gain in the process. The sacrifice becomes prohibitive if an ideal case of zero sensitivity is approached for single loop structures, using simple negative feedback.

In this paper, it is shown that multiloop feedback can be used with advantage for obtaining ideal sensitivity. Use of positive feedback (up to the extent of unity return ratio) in the minor loops and an overall negative feedback improves sensitivity and the signal/noise ratio considerably without loss in gain. The gain-bandwidth product also is not seriously affected. Theoretical values of sensitivity and signal/noise ratio have been verified experimentally for a circuit with two minor loops employing positive fedback and an overall negative feedback loop. The stability has been checked by Nyquist plot.

A Transistor Linear Sweep Generator

Dr. A. K. Chatterjee
Member
and
B. S. Rao
Non-member

The Miller integrator and the Puckle hard valve time base are two different versions of linear sweep generators which are in common use. In this paper, a sweep generator combining the Miller integrator and the Puckle multivibrator and using transistors is described. Improved linearity of the Miller sweep is achieved by allowing a rundown of the sweep capacitor through a large resistance due to the reverse bias condition of the emitter of the transistor T_2 of the Puckle multivibrator. Further improvement in linearity is obtained by using a high gain composite transistor in place of the single transistor.

Radiation at 3 cm. From Swastik Slot Radiator

M. Chaudhuri
Non-member
and
R. L. Shah
Non-member

The foundation of the classical radiation theory is based on the distribution of electric Hertz vector in an electric doublet represented by an antenna, which is short compared with the wavelength of the radiation. The equivalent magnetic radiator is the magnetic dipole; and in radio practice, with longer waves, the only way of realizing it is by means of a loop which is less efficient than an electric one. In microwave radio, however, the half-wave magnetic dipole can be realized by a narrow slot cut in a sufficiently large conducting sheet. A slot cut in a waveguide can be either radiating or non-radiating depending on its orientation with respect to the fields or currents within the transmission system.

Cross and swastik slots and their arrays were cut on waveguide pieces with the help of a pantograph engraving machine. A 20° taper in the slot was given according to the design requirements. An analysis of the radiators was made in regard to the scattering coefficients from which an idea of the insertion loss can be obtained directly, and hence a knowledge of the radiated power. However, the power radiated has not been dealt with in this paper.

A Note on Z-Transform and Circuit Application

T. S. K. V. Iyer
Non-member

As is well known, certain differential equations can be solved by the use of the Laplace transform. Likewise, difference equations can be solved by the use of Z-transforms. The Z-transform was evolved in connection with the theory of sampled data systems and has since been extensively applied for the analysis of antenna arrays. This paper gives an introduction to the Z-transform and its application to circuit analysis.

Design of *R-C* Lead Networks for A.C. Servomechanisms

I. J. Nagrath
Non-member
and
N. N. Shourie
Non-member

A.C. lead networks are one of the many methods of providing compensation for A.C. servomechanisms. These networks operate directly on the envelope of the suppressed carrier modulated signal. Both *R-L-C* and *R-C* networks can be used. However, *R-C* networks are more commonly used because they have the advantage of low cost and small size of components, and are free from the complexity and instability of *R-L-C* networks.

The design method discussed in this paper is based upon Levenstein's theory of A.C. networks. The equivalent transfer function of a notch type *R-C* network for the modulating signal carried by the in-phase carrier is obtained under the approximation that the data frequency is much less than the carrier frequency. This transfer function has a slightly different form than the one commonly used. Using this transfer function, design charts relating reliable data corner frequencies to network parameters and signal attenuation are prepared. The choice of the value of a single component is sufficient to determine the complete network design.

Design charts for bridged-T with resistor or capacitor shunt, symmetric parallel-T with infinite attenuation, and symmetric parallel-T with feedback are included in the paper.

Telecommunications of Indian Railways-Their Progress and Problems

B. V. Sreenivasiah

Associate Member

The telecommunication networks of the Indian Railways are as vast as the Railways themselves. In this paper, their different phases of development are reviewed, their importance stressed, and some of the fundamental problems at present facing them are stated. It is pointed out that with the aid of modern electronics, the telecommunication networks can be used for utilizing the tracks, yards, rolling stocks and locomotives more efficiently.

INSTITUTION NOTICES

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standard Specification for Copper Alloy Tubes for Condensers in Sea-Going Vessels—Doc : SMDC 11(175).

This Standard covers the requirements for tubes of outside diameters from 10 mm. to 40 mm. for condensers used in the manufacture of equipment for sea-going vessels and in situations where hard water is used in condensers.

2. Draft Indian Standard Specification for Nickel Silver Ingots and Castings for Cutlery and Hollow Ware—Doc : SMDC 11(303).

This Standard covers the requirements for three grades of nickel-silver ingots and castings designated as grade 1, grade 2 and grade 3.

Members may send their comments on the above draft Standards before June 30, 1962, to Dr. G. P. Chatterjee (*M.*), Chief Metallurgist, Durgapur Steel Project, P.O. Durgapur Coke Oven, Durgapur, who is the Institution representative on the Sectional Committee dealing with these draft Standards.

3. Draft Indian Standard Code of Practice for Fire Safety of Non-Industrial Buildings—Doc : BDC 12 (463).

This Standard covers the fire safety requirements to be complied with in respect of non-industrial buildings.

Members may send their comments on the above draft Standard before June 30, 1962, to Shri H. P. Sinha (*M.*), Consulting Engineer (Road Development) & Joint Secretary, Ministry of Transport, Roads Wing, Jamnagar House, Shahjahan Road, New Delhi.

Copies of the draft Standards may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 2/21 First Line Beach, Madras 1; or 14/69 Civil Lines, Kanpur.

FORTHCOMING CONFERENCES

Fourth Congress of the Federation Internationale de la Precontrainte, Italy, May 26 to June 2, 1962

The Fourth Congress of the Fédération Internationale de la Précontrainte will be held in Rome and Naples from May 29 to June 2, 1962.

Further details regarding the Conference can be had from the Organizing Secretary, Centro Studi, Ministero dei Lavori, Publici, Porta Pia, Rome, Italy.

Symposium on 'A. C. Railway Electrification', London, July 4, 1962

A Symposium on 'A.C. Railway Electrification' will be held in London on July 4, 1962, under the auspices of the Institution of Electrical Engineers, London. The Symposium will deal with the experience of the British Railways on using the 50 cycles, 25/6.25 kV system of electrification. Subjects covered will include (i) power supply, (ii) some special aspects of the overhead contact system, (iii) conversion of a railway from D.C. to A.C. electrification, (iv) a new electronic testing technique, and (v) the performance of the traction equipments, including those on which failures occurred on the British Railways and the cures adopted. The field covered, extending from the 130 kV grid to electronic devices, will include circuit breakers, transformers, rectifiers, motors, etc.

Further details regarding the Symposium can be had from the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

BOOK ACKNOWLEDGMENTS

1. **Matrices for Structural Analysis.** S. J. Mcminn. *E. & F. N. Spon Ltd.*, 57s. 6d. 210 pages.

This book dealing with the theory of matrices and their application to structural analysis, is intended to serve as a text-book on structural analysis and gives the procedures for calculation of the different numbers from the given data and their assembly into matrices in detail.

2. **Theory of Structures and Strength of Materials.** K. P. Roy Chowdhury. Published by the author, Principal, Engineering School, Jharsuguda, Orissa, 5th edition, Rs. 13. 474 pages.

In this 5th edition of a book dealing with the theory of structure and strength of materials for engineering students, a chapter on moment distribution method and a number of tables and worked out examples have been added.

3. **Strength of Materials.** G. H. Ryder. *B. I. Publications*, Bombay, 3rd edition, Rs. 12. 340 pages.

This third edition of a book intended to serve as a textbook in strength of materials for engineering degree courses is an enlarged version of the second edition and includes more information on material testing and experimental methods, elastic theory, structural analysis, and plastic yielding.

4. **Modern Workshop Technology—Part 1.** H. W. Baker. *B. I. Publications*, Bombay, 2nd edition, Rs. 25.50. 511 pages.

This second edition of a book on workshop technology is a revised and enlarged verison of the first edition, and includes chapters on new casting techniques, production of steel wires and bright steel bars.

5. **A History of Electrical Engineering.** P. Dunsheath. *Faber & Faber*, Ltd., London, 50s. 368 pages.

This book gives the history of electrical engineering from the earliest available records of magnetism up to the present day with reference to the social context of the various discoveries and the lives and characters of the men who made them.

6. **Linear Signal Flow Graphs and Applications.** Y. Chow and E. Cassignol. *John Wiley & Sons, Inc.*, $ 6.95. 144 pages.

This book deals with the principles of signal flow graphs for study of linear systems and is intended to serve as a guide to the students of advanced electrical engineering and research engineers in the field of control system analysis and circuit theory.

7. **Guide to Engineering Drawing.** G. R. Schiffer. *Blackie & Son Ltd.*, 6s. 6d. 42 pages.

This book is intended to serve as a quick reference for guidance of engineering students while working at a drawing, and includes in brief the principles and procedures of engineering drawing including freehand sketching, assembly drawings, sections, limits and tolerances, and surface texture.

8. **Logarithm Steam and Other Tables.** K. P. Roy Chowdhury. Published by the author, 2/19 T. N. Chatterjee Street, Calcutta 50, 0.75 nP. 40 pages.

This book gives four-figure logarithm tables, steam tables, and other tables and scientific engineering data in metric system.

PUBLICATIONS RECEIVED

A publication entitled 'Well Foundations for Road Bridges' has been recently received from the Public Works Department, U.P. It deals with various aspects of and the processes involved in constructing well foundations for road bridges for the guidance of the engineers engaged in such construction work.

A publication entitled 'Tracey Pumping Plant and Intake Canal and Discharging Lines' has been received from the U.S. Department of the Interior, Bureau of Reclamation. It gives a technical record of design and construction of the Tracey pumping plant, intake canals, and discharge lines in California, U.S.A., to transfer excess water from the Sacrament River for supplemental irrigation in the San Joaquin Valley.

LIST OF NEW ELECTIONS & TRANSFERS

(*Continued from the Bulletin for March* 1962)

MEMBERS

No.	Name
2520	Lt.-Col. Srinibas Mishra*
2521	Maliyil Chummar Verghese
2522	Suraj Prakash Datta*
2523	Thakorbhai Ishwerbhai Patel*
2524	Keshinath Vasudeo Joglekar*
2525	Jashbhai Govindbhai Patel*
2526	Shripad Sitaram Apte*
2527	Dr. Kandathil Chacko Thomas*
2528	Arumadura Nandasena Silva Kulasinghe*
2529	Thirunagiri Vijayaragavachari Parthasarathy*
2530	Dina Nath Sud*
2531	Brig. Shamsher Singh*
2532	Stanislaw Szafranski
2533	Brig. Prabha Shanker Gangashanker Trivedi
2534	Uma Nath Jha
2535	T. V. Narayanan Kidao
2536	Robindra Nath Sirkar
2537	Promod Kumar Chatterji
2538	Chuttan Lal Kapur*
2539	Moolraj Odhavji Danani*
2540	Krishna Chandra Gantayet*
2541	Barundur Venkatachaluvaiyengar Raman*
2542	Jal Gustadji Patell*
2543	Sailendra Kumar Roy*
2544	Jai Dev Batra*
2545	Minoo Framji Mobedjina*
2546	Satyapada Mukerji*
2547	C. R. Narayana Rao*
2548	Amiya Kumar Neogy*
2549	Satyendra Prasanna Das*
2550	Arya Bhushan*
2551	J. E. Vaz*
2552	Perwaje Venkatramana Bhat
2553	Lt.-Col. Pushpasinghji Raisinghji Chauhan
2554	Pradyot Ranjan Mukherjee*
2555	Col. Noshir Bayram Grant*
2556	Bangalore Subbaiyer Doraswamy Aiyer*
2557	Upendra Jivanram Bhatt
2558	Prof. Robert Graham Hennes
2559	Prof. James G. Van Vleet
2560	Lt.-Col. Nripendra Mohan Mazumdar*
2561	Mohammad Ebrahim Hussain*
2562	Ramanujapuram Anandampillai Rajagopal*
2563	Wazir Chand Khanna
2564	Balepur Gopal Rao
2565	Anantharam Shamanna Kurpad*
2566	Biswambhar Bose
2567	Brig. Prem Datt Joshi*
2568	Amritlal Vrindavandas Shah*

ASSOCIATE MEMBERS

No.	Name
10004	Vedadri Eswaran
10005	Dipankar Basu
10006	Bisheshwar Mittra
10007	Ashvinkumar Indulal Mehta
10008	Santosh Roy
10009	Bommireddipalli Venkata Gopaul Krishna‡
10010	Mamillapalli Subbaiah†
10011	Lakshmi Narain Gupta†
10012	Manik Chandra Das‡
10013	Sat Dev Khanna
10014	Amulya Kumar Das Gupta
10015	Om Prakash Gupta‡
10016	Kanti Prasad Jain‡
10017	Mohamad Afzal Qazi†
10018	Madhavan Chandrasekharan†
10019	Ganapathy Viswanathan†
10020	Lt.-Col. Prem Sharma

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* Transferred from Associate Member

‡ Transferred from Graduate

† Transferred from Student

ASSOCIATE MEMBERS (*contd.*)

No.	Name	No.	Name
10021	Maj. Mohanlal Kewalram Jhangiani	10048	Gobindo Isardas Mansukhani
10022	Capt. Krishan Sarup Khurana	10049	H. Venkataramanachar Sathyanarayana Rao
10023	Capt. Raja Ram Chandra	10050	Natvarlal Chunilal Sonpal
10024	Sumantrai Khandubhai Desai	10051	Flt.-Lt. Srinivasan Krishaswami
10025	Basant Gadadhar Bhakay	10052	Jayendra Motilal Patel
10026	Trilochan Garabadu	10053	Lt. Pasupuleti Narasimhulu
10027	Sorab Maneckji Desai	10054	Sonti Kameswara Rao†
10028	Anil Ratilal Shah	10055	Capt. Ved Prakash Dhall
10029	Capt. Gajanan Mahadeo Mahajan	10056	Polavarapu Jaganmohana Rao
10030	Prakash Chandra Koshal	10057	Capt. Saroj Kumar Ghosh
10031	Mullamoottil Krishnapillai Chandrasekharan Pillai‡	10058	Subramania Narayana Sarma
10032	Gurudas Anant Shenvi‡	10059	Dhirajlal Chunilal Bhatt
10033	Mahadeva Natarajan†	10060	Bhupendra Ramanlal Merchant
10034	Vanam Singappa	10061	Ratnakar Dinkar Mohile
10035	Chithathurai Adikesavulu Reddi†	10062	Beegamudre Sreedhara Murthy‡
10036	Ananta Dev Sur	10063	Rameshwar Chunilal Navandar
10037	Pravas Kanti Nag	10064	Dhruba Nath Roy
10038	Capt. Ram Krishan Mendiratta	10065	Emani Ananda Rao
10039	Chivukula Sreerama Sarma	10066	Joseph W. Hutchinson
10040	Sudhir Kumar Pande‡	10067	Murti Krishna Moorthy†
10041	Capt. Sitaraman Raman	10068	Prem Chandra Varma
10042	Flg.-Off. Parthasarathy Govindarajan	10069	Jiwan Lal Saghal
10043	Moolchand Baheti	10070	Vasantlal Govardhandas Dua
10044	Hesaraghatta Krishnamurthy Viswanath†	10071	Choulapally Rajagopala Rao
10045	Narain Harjandas Wadhwani	10072	Keshava Ranganath Kusnur
10046	Capt. Hugh Adrian Marley	10073	Flg.-Off. Kuldip Singh‡
10047	Ratilal Hiralal Shah	10074	Kopay Rajamiyengar Srinivas

GRADUATES

No.	Name	No.	Name
1455	Hanuman Prasad Didwania†	1466	Lila Krishan Vij
1456	Kanubhai Prabhudas Patel†	1467	Prahladrai Labhshanker Avasatthi
1457	Bishwa Mohan Kumar Sinha†	1468	Ramchandra Yeshwantrao Soni
1458	Giyarpuram Nadadhur Narasimhan†	1469	Ram Kamal Mishra
1459	Hemraj Chandmal Gandhi	1470	Gulwant Singh Wilkhoo†
1460	Pritam Singh†	1471	Om Sarup Dogra
1461	Shugan Chand Jhari†	1472	Jaswantray Trambaklal Trivedi
1462	Madan Gopal†	1473	Sub-Lt. Subhendu Majumdar
1463	Baldev Raj Chadha	1474	Pravesh Chandra Angiriah†
1464	Mir Ghulam Rasool†	1475	M. Narayanamoorthy Subramanian
1465	Om Prakash Garg†		

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‡ Transferred from Graduate

† Transferred from Student

STUDENTS

No.	Name
30157	Honnavalli Siddappa Siddarama Setty
30158	Desphonde Raghavendrarao Ramamurthy
30159	Sundaram Rangaswamy Sripad
30160	Ravi Kondaiah
30161	Basettihalli Krishnamurthyrao Ramachandra Rao
30162	Devarayasamudram Narayanasastry Ranganathan
30163	Minjasamudram Garudachar Seshadri
30164	Lakshmipuram Narasimhaiyengar Srinivasan
30165	G. Abdul Zahir
30166	Lakshminarayaniah Subramanya
30167	Bal Krishan Shukla
30168	Subh Chander Malhotra
30169	S. Madhavan
30170	R. S. Subba Rao
30171	S. Channigaraya
30172	Ramesh Chandra Sircar
30173	Braj Kishore Prasad
30174	Jagdish Lall
30175	Basavappaji Shiva Kumar
30176	Pralhadarao Bodharao Kulkarni
30177	Smriti Kanta Bandyopadhyay
30178	Kabuljit Singh Thandi
30179	Keshav Kumar Gupta
30180	Rajeshwar Sinha
30181	Dina Nath Singh
30182	Krishna Chandra Jha
30183	Raghavendra Prasad Mathur
30184	Thota Jagadhiswara Rao
30185	Krishna Nand Mishra
30186	Santosh Kumar Chatterjee
30187	Bhag Narain Sinha
30188	Badri Prasad
30189	Ajit Kumar Mukherjee
30190	Mathura Prasad
30191	Ranjit Kumar Modak
30192	Rajendra Prasad Garg
30193	Subhash Chander
30194	Munuswamy Partha Sarathy
30195	Jagdish Lal Lakhanpal
30196	S. Maheshwar
30197	Prem Kumar Seth
30198	Prem Chand Bhatia
30199	Jai Singh Roodkee
30200	Kewal Krishan
30201	Halappa Shiddappa Shiddanagoudar
30202	Devinder Nath Malhi
30203	Baldev Singh
30204	Devendra Singh Parihar
30205	Suryyasen Kanjilal Roy
30206	Kanayo Vensimal Tilwani
30207	Narinder Singh
30208	Raj Mohan
30209	Chander Bhan Gureja
30210	Chander Parkash
30211	Gurmel Singh Grewal
30212	Baldev Krishan Nanda
30213	Bedananda Karmakar
30214	Dinendra Nath Basu
30215	Prabhakar Gadgil
30216	Balkrishan Singh Bedi
30217	Sudershan Lal Bajaj
30218	Balbir Singh
30219	Raghbir Saran
30220	Inder Paul Magoo
30221	Swinder Singh Ahidi
30222	Joginder Kumar Bakhshi
30223	Krishan Mohan Rajvanshi
30224	Darshan Singh
30225	Sarbjit Singh Ahluwalia
30226	Arun Ramchandrarao Sule
30227	Syed Siddique Ahmed
30228	Ram Partap Sharma
30229	Shankar Shioramji Headaoo
30230	Bahadur Singh Bhamra
30231	Harbinder Singh
30232	Bhaskar Vishwanathrao Dindorkar
30233	Anant Narhari Khardenavis
30234	Brij Lal Gupta
30235	Shashikant Udayabhan Wagh
30236	Nand Lal Gupta
30237	Pritam Pal Arora
30238	Prithvi Pal Juneja
30239	Gian Chand
30240	Subhash Chander
30241	Dalip Singh
30242	Surinder Dev Kohli
30243	Govindrao Raghunathrao Kendre
30244	Ram Narain Rastogi
30245	Madhukar Govindappa Saware

STUDENTS (*contd.*)

No.	Name
30246	Nana Govindrao Ghorpade
30247	Binod Bihari Lal
30248	Samir Kumar Mitra
30249	Devendra Kishore Prasad
30250	Parmanand Sinha
30251	Suresh Kumar Saran
30252	Suraj Narayan Singh
30253	Bimala Charan
30254	Deba Prasad Gupta
30255	Ram Naresh Singh
30256	Yamuna Prasad Vishwakarma
30257	Hridaya Nand Sahai
30258	Ramanchettiar Karuppanchettiar Subramanian
30259	Ishwar Dayal
30260	Arjun Kumar K. Rajwani
30261	Jagdish Rai Sood
30262	Harish Kumar Bhatnagar
30263	Balvir Gupta
30264	Parkash Lal Thareja
30265	Chandrakant Manilal Doshi
30266	Shamakant Gajanan Bapat
30267	Kanai Lal Sarkar
30268	Ram Chandra Bhattar
30269	Hiro Tahilram Ajwani
30270	Jayant Panchawagh
30271	Norbert Desouza
30272	Somendra Narayan Chakrabortty
30273	Gustasp Behramji Jussawala
30274	Madhu Sudan Sahay
30275	Mumtaz Ullah Khan
30276	K. M. Sankaran Namboodripad
30277	Bipin Bihari Verma
30278	Devendra Prasad Singh
30279	Ganesh Jha
30280	Ratan Krishna Das
30281	Sourindra Nath Chatterjee
30282	Suraj Bhan Singal
30283	Mahendrakumar Khandubhai Desai
30284	Herkishin Khubchand Shahani
30285	Manubhai Gopalbhai Mistry
30286	Damodar Dattatraya Pol
30287	Balwant Rajaram Nagpurkar
30288	Bimal Kumar Chatterjee
30289	Sadanand Namdeo Mone
30290	Om Prakash Harkut
30291	Shantilal Nanchand Shaha
30292	Rajeshwar Nath Dhawan
30293	Sunder Shyam
30294	Bhawani Das Arora
30295	Mani Mohan Kundu
30296	Raja Ram Sharma
30297	Rajendra Kumar
30298	Ram Kumar
30299	Susil Kumar Mohanty
30300	Vijay Vinayak Joshi
30301	Hari Raj Singh Chaudhari
30302	Harish Chandra Todi
30303	Omprakash Naubatram Lashkari
30304	Shiv Kumar Chandak
30305	Devendra Misra
30306	Vinodkumar Ayodhyaprasad Nigam
30307	Harnam Das Arora
30308	Nand Ram Singh Tyagi
30309	Nand Kishore Sharma
30310	Ram Chandra Srivastava
30311	Dattatraya Pandurang Mhaiskar
30312	Ghanshyam Fatehchand Mookchandani
30313	Shashikant Vishnu Athavale
30314	Lakhpat Rai Bhardwaj
30315	Sudhir Vasant Rashingkar
30316	Ramchandra Shankar Keskar
30317	Sudam Rangnath Harisangam
30318	Vasudeo Pandurang Hasamnis
30319	Bhaskar Govind Joshi
30320	Rambhau Narayanrao Pandhare
30321	Cpl. Awtar Singh Dilawari
30322	Bal Swarup Kapoor
30323	Brij Prakash Sharma
30324	Ram Kirty Grotra
30325	Gopal Ramchandra Garag
30326	Prem Narayan Pandey
30327	Vishwanath Vasudeo Parkhi
30328	Khanderao Trimbak Kulkarni
30329	Satish Chandra Mital
30330	Shankar Parasram Vachani
30331	Baldev Raj Arora
30332	Shiv Nath Bhargava
30333	Prahlad Jayantilal Boghani
30334	Hari Prakash Aggarwal
30335	Swaroop Prakash Vyas
30336	Amrik Singh Phull

STUDENTS (*contd.*)

No.	Name
30337	Ram Sahai Sharma
30338	Satish Kumar Ahuja
30339	Swami Parshad Malhotra
30340	Govind Dattatraya Khire
30341	Narendra Singh Verma
30342	Bharat Ramchand Gandhi
30343	Bhawarlal Jain
30344	Suresh Kumar Khanna
30345	Balkrishna Gajanan Kulkarni
30346	Vasant Damodar Kulkarni
30347	Ashok Vishwanath Limaye
30348	Harishchandra Dattatraya Rao
30349	Ram Narain Mehta
30350	Shanti Prakash Vyas
30351	Shivaji Krishnarao Ghatage
30352	Kanhaiya Lal Varshney
30353	Mahanbir Singh Dhillon
30354	Ramesh Sonu Patil
30355	Suraj Bans Dayal
30356	Shrikant Vishwanath Wagle
30357	Prabhakar Nagnath Joshi
30358	Gauri Shanker Singh
30359	Shashikant Raghunath Kurlekar
30360	Vishwanath Digambar Kulkarni
30361	Kushal Pal Singh
30362	Partap Singh
30363	Mahendra Singh Gothalwal
30364	Kashinath Shankar Kale
30365	Roshan Lal Kapoor
30366	Ram Partap Gupta
30367	Shyam Sunder Ramdeo
30368	Narendra Bhalchandra Kotnis
30369	Rajinder Lal Khitha
30370	Bhimbhai Gobindram Chichra
30371	Bhim Sain Chopra
30372	Govind Dhondo Joshi
30373	Manik Baburao Gaikwad
30374	Pandurang Vasudeo Majumdar
30375	Lalit Kishore Trivedi
30376	Suresh Dattatraya Raverkar
30377	Dev Karan Gupta
30378	Naresh Chand Jain
30379	Jagdish Mitter Khetarpal
30380	P. Narasimha Bhat
30381	Onkar Prasad
30382	Padmakar Yeshwant Sathe
30383	Vinod Kumar Sharma
30384	Madan Lal Narula
30385	Krishan Kumar Kathuria
30386	Hardyal Singh Virdee
30387	Mokala Venkateswara Rao
30388	Madhukar Dada Jakhadi
30389	Bhagwati Lal Mantri
30390	Sharatchandra Manjunathrao Shirali
30391	Dhondiram Ramchandra Patil
30392	Ratan Lal
30393	Vijay Narain Saharia
30394	Ravindra Nath Bhargava
30395	Virainder Chander Jain
30396	Vinayak Dattatraya Kulkarni
30397	Vijay Kumar Khanna
30398	Parshotam Singh Ahluwalia
30399	Pooralkulam George Daniel Kuruvilla
30400	Vinayak Pandurang Desture
30401	Prasanta Gupta
30402	Navanitlal Manilal Shah
30403	Raj Kumar Chandna
30404	Mundakkal Sankara Narayanan Menon
30405	Sopan Punja Shete
30406	Satya Paul Rawal
30407	Ved Prakash
30408	Bal Krishna Gupta
30409	Ibrahim Madhur
30410	Krishan Kumar Bhalla
30411	Ramchandra Maruti Patil
30412	Bhajan Singh Kalsey
30413	Davendra Kumar Dinesh
30414	Dhansingh Mohansingh Rajput
30415	Parmanand Bilandrai Matnani
30416	Tulshiram Totaram Patil
30417	Govind Dharmaji Jagtap
30418	Govind Narayan Patil
30419	Cranganore Narayanaier Narayanan
30420	Ravinder Kumar Gupta
30421	Harish Chander Gurwara
30422	Chintamani Pandeya
30423	Anilkumar Ukabhai Patel
30424	R. Gopalakrishna Pillai
30425	Kailash Nath
30426	Rajinder Mohan
30427	Sayed Farooq Ali
30428	Sharad Chandra Vishwarup

STUDENTS (*contd.*)

No.	Name
30429	Harnam Singh
30430	Balkrishna Raghunath Anegal
30431	Jiwan Parkash Jain
30432	Dattatraya Shankar Zute
30433	Kerehalli Satyanarayana Setty
30434	Jia Lal Jain
30435	Kishin Hotchand Punjabi
30436	Mohammad Muslim
30437	Jetho Varumal Menghani
30438	Hiralal Gupta
30439	Yamunashanker Shyamlal Sharma
30440	Trilochan Singh Prem
30441	Thakorbhai Kalyanji Mistry
30442	Harivadan Gopaldas Pandya
30443	Jagdish Ambalal Upadhyaya
30444	Pranaykumar Ushakant Dholakia
30445	Ramachandra Dashrath Dhere
30446	Nandikotkur Sreenivasa Moorthy
30447	Kanduri Veera Venkata Satyanarayana
30448	Babubhai Prabhudas Patel
30449	Bhagwandas Biharidas Bokade
30450	Ravendra Kumar Saxena
30451	Balkrishna Sakharam Pawar
30452	Narendra Popatlal Shah
30453	Madhukar Shankar Patil
30454	Thakur Das Daryana
30455	Trilok Chand
30456	M. Arumukhom Pillai
30457	Sudershan Lal Batheja
30458	K. Duraisamy
30459	Jjoti Prasad Goel
30460	Suraj Bali Singh Parihar
30461	Vishwa Nath Agarwal
30462	Mohan Motumal Radhwani
30463	Om Prakash Juneja
30464	Surat Nirmaldas Panjabi
30465	Vinod Kumar Nayyar
30466	Om Prakash Agrawal
30467	Rameshwar Dayal Sharma
30468	Prabhakar Shambhurao Chitale
30469	Jayant Ganesh Phatak
30470	Ramesh Kumar
30471	Vijaysing Haridas Udeshi
30472	Madan Mohan Bagga
30473	Bimal Kumar Ghosh
30474	Chander Mohan Sharma
30475	Suryakant Laxman Phatak
30476	Chittaranjan Ray
30477	Baskaraiyer Krishnamoorthy
30478	Prabhakar Appaji Sarnaik
30479	Omji Dhar
30480	Hari Mohan Singh
30481	Rampal Sharma
30482	Vasant Vishwanath Bapat
30483	Krishnaji Hanmant Bakshi
30484	V. G. James
30485	Erode Subramanyam Mohan Sundar
30486	Mansur Salehbhai Zakvi
30487	Farrokh Dadiba Gowadia
30488	Om Prakash Sinha
30489	Dwarka Prasad Kacher
30490	Prem Shanker
30491	Jairaj Gautamlal Lall
30492	Hiro Vishindas Chainani
30493	Gulab Lokumal Thadhani
30494	Ramaswami Srinivasan
30495	Ramakrishnaiyer Lakshminarayana Ayyar
30496	Chainrai Sugnomal Pohani
30497	Ramchandra Shivram Mandpe
30498	Shiv Kumar Singh Chauhan
30499	Ved Raj
30500	Nishikant Narayan Kale
30501	Ram Kishan Sharma
30502	Kunchithapatham Lakshmanan
30503	Kamaleshwar Bhatt
30504	Bipin Kashinath Pole
30505	Gurmukh Sadhwani
30506	Jamil Ahmad Ansari
30507	Shiv Dayal Verma
30508	Govind Mohan Garg
30509	Kashmiri Lal
30510	Vasudeo Balkrishna Deshpande
30511	Narendra Kumar Gangal
30512	Rajendra Prakash Singhal
30513	Bhalchandra Shamrao Deshmukh
30514	Balaram Dey
30515	Ramchandra Shriniwas Manurkar
30516	Kedar Nath Singh
30517	M. S. Balakrishnan
30518	Bhagat Ram Sharma
30519	Surrinder Singh Chauhan
30520	Yuwaraj Nathuji Rodey

STUDENTS (*contd.*)

No.	Name
30521	Ram Sarup Malhotra
30522	Sirvender Singh Oberoi
30523	Banwari Lal Agarwal
30524	Krishan Kumar Kalra
30525	Krishnakant Gaurishanker Rawal
30526	Dev Raj Shahi
30527	Pralay Bahadur Yadava
30528	Shyam Bihari Singh
30529	Vidya Sagar
30530	Janeshwor Prasad Jain
30531	Mohanlal Vashrambhai Parsana
30532	Suraj Pal Singh Rana
30533	Harjinder Singh Bhambra
30534	Amar Nath Narang
30535	Dhirendrakumar Gaurishanker Chaturvedi
30536	Virender Kumar Thapar
30537	Ranjit Kumar
30538	Shamrao Keshavrao Sabnis
30539	Narendra Pratap Singh
30540	Shamkant Gopinath Patankar
30541	Krishnamurthy Vaidyanathan Iyer
30542	Vishwa Mittar Mahajan
30543	Kuppuswamy Ramanathan
30544	Ram Tirath
30545	Rajendra Kumar Mishra
30546	Sharwan Kumar
30547	Rajendra Mohan
30548	Laikongbam Mangol Singh
30549	Kailash Rai Chopra
30550	Radha Raman
30551	Bal Krishna Agrawal
30552	Manohar Lal Adhlakha
30553	Ved Prakash Sharma
30554	Ram Chet Singh
30555	Puran Chand Mittal
30556	Virendar Mohan Sharma
30557	Saiyed Ahmed Hasan Rizvi
30558	Padmakar Krishnarao Koranne
30559	Deep Singh Tomar
30560	Benche Lal Saksena
30561	Yash Pal Kalia
30562	Bhagwan Harjasrai Wadhwani
30563	Haripal Singh
30564	Satya Pal Singh Rana
30565	H. A. Lakshman Rao
30566	Mahesh Kumar Khurana
30567	Surampally Venkat Rao
30568	Hebri Sreenivas Kamath
30569	Satya Brata Chatterjee
30570	Ram Lal
30571	Dharam Pal
30572	Ved Parkash Wadhwa
30573	Satya Prakash Gupta
30574	S. Rama Bhat
30575	Ram Krishna Rastogi
30576	Sunder Sham
30577	Sukhdev Singh Grewal
30578	Moorkoth Balan
30579	Devinder Kumar Khullar
30580	Jwala Singh
30581	Tarsem Lal
30582	Sushil Kumar Jhanjee
30583	Radhe Shyam Madan
30584	Gurmit Singh Grewal
30585	Bantwal Muralidhara Hedge
30586	K. R. Bhaskra Kurup
30587	Baldev Krishan Chadha
30588	Raj Kumar Kapur
30589	Tadivaka Bhimasankara Rao
30590	Sudhir Mohan Khosla
30591	Venkatachalam Viswanath
30592	Vijai Kumar Maheshwari
30593	Vasudeo Gururao Sangli
30594	Wahed Haiderally Lunavadawala
30595	Kodakanallur Seetharaman Ramaswami
30596	Om Parkash Dhiman
30597	Meghraj Singh Jain
30598	Satish Chandra Shukla
30599	Gurdayal Singh Bhalla
30600	Subramanya Krishnamurthy
30601	Bansi Lal Tuli
30602	Arun Narayan Phadnis
30603	Vinayak Ramrao Choudhari
30604	Bachaspati Nautiyal
30605	Chander Mohan Chawla
30606	Vishwanath Narayan Dixit
30607	Brij Mohan Lal Goyal
30608	Sohan Lal
30609	Tanguturi Kothanda Ramaiah
30610	Guran Ditta
30611	Yella Rangappa

STUDENTS (*contd*)

No.	Name
30612	Sunil Chandra Basak
30613	Alamuru Venkata Suryanarayana Sarma
30614	Ram Sharan Gupta
30615	Panyam Narasimha Rao
30616	Satya Brata Paul Roy
30617	Rattan Sagar Vasisht
30618	Gurmit Singh Council
30619	Sewa Ram
30620	A. M. Thomas
30621	Sheshagiri Narasimharao Koulgi
30622	Dhruba Charan Hota
30623	Achyutananda Pattanayak
30624	Lalit Mohan Misra
30625	Adhiraja Mohana Senapaty
30626	Shivo Awatraman
30627	Veeravanallur Sundaram Krishnamurthy
30628	Debesh Chandra Ghoshal
30629	Bhagirathi Padhy
30630	Sangram Keshari Sinha
30631	Rasananda Swain
30632	Delip Kumar Mukherji
30633	Katakota Raghunath Subudhi
30634	Sudarshan Panda
30635	Krupasindhu Nanda
30636	Joginder Paul Goyal
30637	Lila Kanta Dutta
30638	Mahadevapura Krishnarao Ranganatha Rao
30639	Nagendra Narayana Pattanaik
30640	Peshimam Muneer Ahmed
30641	Syed Mohammed Baqar Naqvi
30642	Sailaja Kanto Mukhopadhyay
30643	Savaram Nagabhushana Rao
30644	Purushottam Nathabhai Rana
30645	Raj Pal Sharma
30646	Meka Sambasiva Rao
30647	Parvataneni Raja Ramamohana Roy
30648	G. A. Vykuntam
30649	Shiram Madhavrao Bari
30650	Vinnakota Venkateswara Rao
30651	Surya Kant Verma
30652	Gothuru Lakshmikantam
30653	Yeleswarapu Venkateswara Rao
30654	Narapareddy Chandrasekhar Reddy
30655	Bammidi Durga Prasada Rao
30656	Mohammed Saimullah
30657	Nimbalkar Bheem Rao
30658	Govind Pershad Sharma
30659	Karuna Sindhu Pasari
30660	Mrinal Kanti Roy
30661	Prabha Shankar Srivastava
30662	Mrinal Kanti Mondal
30663	Kasaghatta Anantharamiah Ramachandra Murthy
30664	Amalendu Bhattacharyya
30665	Mihir Baran Majumder
30666	Radhe Shyam Pande
30667	Satya Narayan Nayak
30668	Kavuri Venkata Vamana Rao
30669	K. S. Raghupathy Iyer
30670	Peddinti Butchi Reddy
30671	Govind Chandra Tripathy
0672	Katta Venkateswarlu
30673	Naresh Chand Singal
30674	Arabinda Sekhar Mukherjee
30675	Karri Bhaskara Rao
30676	Kuttalam Swaminathan Subramanian
30677	Goberdhan Behuria
30678	Subramanyam Krishnamoorthy
30679	Nekasi Sinh Bhadoria
30680	Keesara Lakshmi Narasimha Sarma
30681	Kali Pada Ghosh
30682	Ramarapu Venkat Rao
30683	Kshirod Prosad Mohanty
30684	Ganti Veerabhadram
30685	Rattan Mamtani
30686	Balkrishna Shripad Shelolikar
30687	Dilip Kumar Gupta
30688	Benit Chakraborty
30689	Bishnu Pada Kar
30690	Nirmal Chandra Bandyopadhyay
30691	Dhirendra Nath Dey
30692	Ashvini Kumar Seth
30693	Bharat Chandra Mandal
30694	Dhiraj Gobinda Chakraborty
30695	Anindya Kumar Sen
30696	Jamnadas Gopalji Madhwani
30697	Sukumar Das
30698	Makhan Lal Mandal
30699	Padum Chandra Borthakur
30700	Purini Sreenivasulu
30701	Adhir Kumar Chaki
30702	Devarakonda Sriramamoorty

STUDENTS (*contd.*)

No.	Name
30703	Maka Venkataramanaiah
30704	Sunkara Subba Rama Reddi
30705	E. Seshadri
30706	Mohinder Singh Khanna
30707	Kunal Kumar Nandi
30708	Narendra Nath Sahoo
30709	Achintya Kumar Saha
30710	Devendra Gope
30711	Hari Nath Rai
30712	Dibyendu Biswas
30713	Ramanath Sarangi
30714	Indromohan Prodhan
30715	Santosh Kumar Chowdhury
30716	Sajal Kanti Ghosh
30717	Ramesh Chandra Gaur
30718	Bimalesh Saha
30719	Rangachar Kuppaswamy
30720	Laxminarayan
30721	Bhima Charan Samal
30722	Aachi Ramachary
30723	Vedula Kameswara Rao
30724	Arun Kumar Kundu
30725	Sankar Prosad Mitra
30726	Vijay Kumar Mathur
30727	Venneti Veerabhadra Rao
30728	Kondragunta Subbaramaiah
30729	Satyapriya Mitra
30730	Komma Mallaiah
30731	Madan Mohan Lal Dodeja
30732	Bijoy Krishna Nath
30733	Harshad Sumanchandra Shah
30734	Tamal Krishna Pal
30735	Sailaja Prosad Bankundy
30736	Nitai Kumar Mukherjee
30737	Swapan Kumar Chattopadhyay
30738	Bhupendra Singha Roy
30739	Phanindra Nath Roy
30740	Kamal Chandra Basu
30741	Ajit Kumar Banerjee
30742	Subhendu Kumar Ghosh
30743	Subhabrata Banerjee
30744	Tarun Kumar Das
30745	Kidar Nath Seth
30746	Nirmal Chandra Rautray
30747	Perumenki Venkata Narasimha Rao
30748	Murarilal Garg
30749	Sushil Chandra Karmakar
30750	Subhas Chandra Chakrabarti
30751	Yalaka Govinda Reddy
30752	Kanapura Srikantiah Subramanyam
30753	B. K. Seetharam
30754	Kuchimanchi Venkata Ramana Murthy
30755	Kumbheshi Srinivasarao Padmanabha Rao
30756	Hommenahalli Seetharamaiah Dwarakanath
30757	N. Ganapathy Subramanian
30758	Arun Krishnaji Sarawate
30759	Madan Kumar Suri
30760	Abdul Khayum
30761	Dinesh Chandra Roy
30762	Katta Vijayamohan
30763	Chandrakant Date
30764	Arun Shripad Kirloskar
30765	Ivaturi Parvateesam
30766	Kadambi Varadarajulu
30767	Mallareddi Kariyallareddi Hosalli
30768	Banavathi Subbarao Srirama Murthy
30769	Gibikote Subbarao Nagaraja Rao
30770	Yalala Subba Rao
30771	Sarva Kameswara Rao
30772	Dev Kumar Anand
30773	Narsingh Shanti Chand
30774	Subhash Chandra Mehta
30775	Narayan Raghavachar Shankhavaram
30776	Anne Radha Krishna Rao
30777	M. Mohiuddin Khan
30778	Shivinder Shah Chawla
30779	Saroj Kumar Mukhopadhyay
30780	Baini Singh
30781	Durbha Sanyasi Rao
30782	Madhav Shankar Purandare
30783	Kancherla Venkateswara Rao
30784	Diwakar Dinkar Parkhi
30785	Satish Kumar
30786	Shiben Krishen Kachru
30787	Saranga Venkata Rama Murthy
30788	R. Somasundaram Pillai
30789	Umakanta Mohanty
30790	Jagadish Chandra Dey
30791	Chodavarapu Radhakrishna
30792	Chidambara Ramappa Anaji
30793	Gorur Narasimhachar Srinath
30794	Tiruvaipati Karuna Sagar

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No.	Name
30795	Allampalli Venkatarama Rajagopala Adiga
30796	Sharadkumar Shrinivasrao Lokur
30797	Vinayak Mahadeo Bhide
30798	Bhagabati Prasad Patnaik
30799	Shamsunder Shridharrao Indapwar
30800	Habibur Rahman
30801	Roop Krishna Tripathi
30802	Kanaya Lal Chandiramani
30803	Shaik Abdul Rahim
30804	M. K. Seshadri
30805	Manindra Chandra Chakraborty
30806	Kuntimaddi Vedantam Krishna
30807	Yellapragada Radha Krishna Murthy
30808	Jaswant Singh Bhatia
30809	Nilkanth Trimbak Bapat
30810	Ramdas Chowdhury
30811	Kishor Manharlal Dave
30812	Raj Kishore Singh
30813	Thomas J. Mannanal
30814	N. Narakesari
30815	Hosakere Shankarabhatta Shivashankara
30816	Jagjit Singh
30817	Kailash Nath Trivedi
30818	D. Charles Irwin
30819	Srinivasan Seshan
30820	E. John Bunyan
30821	Joginder Lal Lamba
30822	Karnail Singh
30823	Bepin Behari Bansal
30824	Surendra Bahadur
30825	N. Sambasivan
30826	Notu Thakurdas Hiranandani
30827	Kuduvalli Ramaswami Krishnamurthy
30828	Dhirendra Chandra Pal
30829	Suraj Parkash Chawla
30830	Manohardas Hundraj Asnani
30831	Iqbal Hussain
30832	Raj Kumar Singhal
30833	Pijus Kanti Das Gupta
30834	Tulsi Das
30835	Vemula Rama Rao
30836	Ravi Kant Verma
30837	Krishna Chandra Kundu
30838	Kharaiti Lal Chandna
30839	Des Raj Saini
30840	Gopalrai Teumal Chatwani
30841	Jamuna Prasad Pathak
30842	Ram Baksh Pal
30843	Narendra Kumar Tandon
30844	Jainti Prasad Jain
30845	Sachchidananda Deb Purkayastha
30846	Tribhawan Singh Gill
30847	Babul Lal Vyas
30848	Potamber Singh Jolly
30849	Binod Bihari Prasad
30850	Bashistha Muni Mishra
30851	Hardial Singh Bedi
30852	Shyam Sunder
30853	Othayamangalath Sivasankaran Nair
30854	Kanwar Sen
30855	Parma Nand Singh
30856	Anant Jha
30857	Satya Pal Wahi
30858	Mohanlal Odhavjibhai Kakadia
30859	Tulsi Das Ahuja
30860	Ramesh Chand
30861	Rohan Lal
30862	Ram Chandra Prasad Gupta
30863	Hari Har Nath Tripathi
30864	Siladitya Ghosh
30865	Mahendra Prakash Agrawal
30866	Sudhansu Kumar Roy
30867	Baburao Laxmanrao Khedkar
30868	Tribhuan Nath Yadava
30869	Mohinder Singh
30870	Gonnuri Satyanarayana
30871	Rajendra Singh Sirohi
30872	Kanahiya Lal Raisinghani
30873	Satish Pratap
30874	Virendra Kumar Dube
30875	Shyam Bahadur Asthana
30876	Ramesh Prakash Goel
30877	Balbir Krishan Behal
30878	Pravinchandra Fulchand Doshi
30879	Murari Lal
30880	Pyare Lall
30881	Dilip Kumar Burman Roy
30882	Asim Chandra Kumar
30883	Behari Lal
30884	Yash Pal Varmani
30885	Sulakshan Kumar
30886	Mitter Sain Kapla

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No.	Name
30887	Gurcharan Singh
30888	Sheomangal Prasad Sinha
30889	Gurbachan Singh Randhawa
30890	Dharam Singh Channa
30891	Raghbir Singh
30892	Ishwarbhai Vanmalidas Patel
30893	Puran Lal
30894	Pramodchandra Chhaganlal Desai
30895	Rajanala Bangaru Seshu Babu
30896	Coimbatore Ramanath Jayaraman
30897	Jodh Raj Gupta
30898	Rajinder Kumar Anand
30899	Animesh Kumar Mittra
30900	Paramatma Nand Ojha
30901	Satya Narayan Gupta
30902	Arun Kumar Chaudhury
30903	Indra Singh Rawat
30904	K. Balasubramanian
30905	Badri Prashad Srivastava
30906	Vijay Kumar Chhurra
30907	Vadilal Ganpatram Thakkar
30908	Kota Ramakrishna Rao
30909	Baldev Datt
30910	Ram Chandra Saini
30911	Ashok Rudra
30912	Rachakonda Rama Sastry
30913	Manas Kumar Hazra
30914	Harish Chander Khaneja
30915	Ramesh Kumar Sikka
30916	Ashit Baran Sinha
30917	Amrik Singh
30918	Inderjit Singh Bedi
30919	Narendra Singh Khichi
30920	Prabhas Chandra Dutta
30921	Kantilal Ratanshi Lodaya
30922	A. Meganathan
30923	Prabh Dyal Singh Bhalla
30924	Arun Kumar Datta
30925	Naranjan Singh Nijjar
30926	Mathirappilly T. Raphael
30927	Vishnuprasad Shobharam Raval
30928	Sita Ram Prasad
30929	Mohinder Kumar Saini
30930	Rajendra Kumar Jain
30931	Satyamurthi Satagopan
30932	Jawahar Tarachand Chand
30933	Mahesh Singh Thakur
30934	Bongshi Dhar Kumbhakar
30935	Satnam Singh
30936	Kallanmar Thodiyil Parameswaran
30937	Sarvottam Sanatkumar Majmundar
30938	Jibkant Jha
30939	Swami Dayal Srivastava
30940	Surinder Kumar Aggarwal
30941	Khem Singh
30942	Upendra Narayan Sinha
30943	Awadh Narayan Sharma
30944	Suresh Prasad
30945	Madan Mohan Singh
30946	Ramkumar Maheshwari
30947	Harjit Singh
30948	Gurcharan Singh Lall
30949	Bhim Sain Mehta
30950	Surjit Singh Atwal
30951	Kaushlendra Kumar Sharma
30952	Gopal Mahadeo Deshpande
30953	Jugal Kishore Bhola
30954	Parbat Singh Panwar
30955	Ramesh Chandra Gupta
30956	Santosh Kumar Mohanty
30957	Lakshminarayana Harihara Subramanian
30958	Kuldip Singh Sidhu
30959	Uday Sankar Gangopadhyay
30960	Chhatra Singh Thakur
30961	Sambhu Narayan Panda
30962	Satish Chandra Paul
30963	Biharilal Chaturbhuja Mehta
30964	Inder Mohan Lal
30965	Amar Kumar
30966	Sukhdev Singh Pannu
30967	Ram Charan Gupta
30968	Narinder Kumar Bhatia
30969	Bootha Venkata Ramanamurty
30970	Brij Mohan Gulati
30971	Minoo Bamanshaw Mistry
30972	Manmohan Krishan
30973	Samarendra Nath Mukherjee
30974	Jai Dayal Rawal
30975	Kalyanasundaram Krishnamurthy
30976	Binod Bihari Samal
30977	G. Sundaresan
30978	Dattatraya Shridhar Sainis

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No.	Name
30979	Yoginder Dev Tewari
30980	Lajpat Rai Vij
30981	Vasant Heramba Kulkarni
30982	Manickam Dharmaboopathy
30983	Udai Narain Mall
30984	Arunkumar Ganesh Shende
30985	Amar Singh
30986	Vijay Kumar
30987	Amitava Senmajumder
30988	Sadgurunath Purushottam Prabhu
30989	Vasudevrao Kulkarni
30990	Sham Prabhakar Mukhedkar
30991	Dharam Pal Bajaj
30992	R. Devanathan
30993	Birendra Kumar Roy
30994	Vishnudas Sahebram Jaju
30995	Suresh Vinayak Bapat
30996	Khagendra Nath Saikia
30997	Krishnapur Lakshmanasastry Nagaraja
30998	Bansi Lal
30999	Abhik Kumar Mukhopadhyay
31000	Mutyam Ramachandra Sastry
31001	Pidi Suryaprakasa Rao
31002	Ratnakar Panday
31003	Narendra Vishnu Walavalkar
31004	C. Ittoop Rajan
31005	N. K. Subramanian
31006	Prakash Vishindas Chainani
31007	Rabindra Nath Nag
31008	Ayallur Vedamiyer Viswanathan
31009	S. Hari Rao
31010	Amar Singh Sobal
31011	Avinash Parkash Gandhi
31012	M. E. Gopalakrishnan
31013	Sumaithangi Sundararama Krishnamurthy
31014	Ratnakar Shidramappa Kalyanashetti
31015	Satyesh Chandra Roy
31016	R. Narasimhan
31017	Siva Prosad Bhattacharyya
31018	Alok Dev Chatterji
31019	L. Subramanian
31020	Doraiswami Sankaranarayanan
31021	Nott Raghunathan
31022	Bhanu Jacob Mathews
31023	Harry Gupta
31024	V. N. Ramu
31025	Abbaraju Ram Chander
31026	Ranendra Nath Pal
31027	Manoharlal Peswani
31028	Ananda Rajavaran
31029	Gopalakrishnan Ramiah
31030	Ami Chandra Verma
31031	Doulat Pararam Keswani
31032	Ram Saran Sharma
31033	Uma Charan Roy
31034	Dulal Krishna Biswas
31035	Kandasamy Mudaliar Thangavelu
31036	Jai Kishin Jagwani
31037	Bijoy Krishna Das
31038	Kumaraswamy Sivashunmugam
31039	D. Sugavanam
31040	L. Krishna Murthy
31041	Swaran Lal Bhardwaj
31042	Goru Kanna Rao
31043	Inna Vedavyasa Sharma
31044	Bindiganavale Ramanna Krishna Prasad
31045	D. Rangarajan
31046	Narayanan Srinivasan
31047	Gobichettypalayam Ramanathan Ramachandran
31048	Lingambhotla Madhava Rao
31049	Ramaswamy Thirunarayanan
31050	Devinder Kumar Mehta
31051	Sakti Pada Sinha
31052	Krishnaswamy Subramanian
31053	Kondapaneni Venkata Gopala Rao
31054	Krishnaiyer Ramachandran
31055	G. V. Pushparaj
31056	Chodavarapu Laxmi Krishna Mohana Rao
31057	Jawahar Lal Kapoor
31058	Manimangalam Vijayarangam Krishnamurthy
31059	Rajagopalan Venkataraman
31060	K. Viswanathan
31061	Karunappa Krishna Raj
31062	N. Vinayaka Rao
31063	Pedda Gondi Venugopal
31064	Rajappa Sreenivasan
31065	Narendra Nath Gupta
31066	Syed Jawwad Ali Rizvi
31067	Hari Prakash Sharma

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No.	Name	No.	Name
31068	Dina Nath Bajaj	31114	Vedagiri Saravana Bhavan
31069	Prabhakar Ramkrishna Bhandarkar	31115	Bhagwat Swarup Goel
31070	Subarnabindu Datta	31116	Shyam Sharan Pipil
31071	Ram Chandra	31117	Sushil Chandra De
31072	Manis Sen Gupta	31118	Tulsi Dhalumal Dharmani
31073	Sudhangshu Bhushan Gon	31119	Kanad Kanti Paul
31074	Biswanath Mukherjee	31120	Khagendra Nath Pathak
31075	Saroj Kumar Mondal	31121	Madhav Vinayakkrao Ghirnikar
31076	Nirmal Kanti Kundu	31122	Subhas Chander Chagh
31077	Samirbaran Ghoshroychowdhuri	31123	Guranditta Bhatia
31078	Biswanath Biswas	31124	Ramendra Krishna Paul
31079	Swapan Kumar Banerjee	31125	T. S. Srinivasan
31080	Basant Kumar	31126	Rajagopalachari Vasudevan
31081	Harishchandra Ramachandra Gujar	31127	Venkatarama Ramachandran
31082	Anath Bandhu Sarcar	31128	Kishan Dutta Sharma
31083	Trichy Yoganandam Sundaramoorthy	31129	Roop Nath Dhar
31084	Om Prakash	31130	Surya Prakash Gurwara
31085	Anand Gulabrai Showkeen	31131	Abhey Kumar Jain
31086	Kothawal Venkatesalu	31132	Krishna Kumar Saxena
31087	Rajendra Singh	31133	Vilas Sadashiv Sawant
31088	Sudarshan Kumar Vasisht	31134	Narindra Kumar
31089	L. Srinivasan	31135	Kersi Soran Parekh
31090	Jaikrishin Gobindram Idnani	31136	Prabhakar Uddhav Phondba
31091	J Madhusudhan Reddy	31137	Vijaykumar Charles Joseph
31092	Ram Parkash	31138	Ashok Eranna Korba
31093	Ramesh Vishnu Shrotriya	31139	Rajender Parshad Sharma
31094	Anant Baburao Deokar	31140	Indra Deo Misra
31095	Arun Damodar Gokhale	31141	Mahadeo Jairam Pimple
31096	T. P. Siddanathan	31142	A. Guru
31097	Sudhakar Ganesh Ranade	31143	Mohan Singh
31098	Jai Bhagwan Sharma	31144	Srinivasa Venkataramani
31099	M. Panayadi	31145	Manavazhi Jayakrishnan
31100	Meenakshisundaram Balakrishnan	31146	N. Sivan
31101	Satish Chander Sharma	31147	Shri Mohan Bansal
31102	Rahul Krishna Chowdhury	31148	S. Ramaswamy Iyer
31103	Iqbal Singh	31149	P. Balakrishna Rao
31104	Khan Chand	31150	Subhash Keshav Mulye
31105	Bangalore Annamalay Uvaraj	31151	Ratnakar Purushottam Khiste
31106	Chirayil Anthoney Antony	31152	Madhav Narhar Kelkar
31107	K. Venkatesh Shenoy	31153	Govind Raghunath Kulkarni
31108	Prem Verdhan Wason	31154	K. A. Ramaswamy Iyer
31109	A. Rami Reddi	31155	Sureshchandra Shyamswarup Saxena
31110	Ravindra Narayan Gore	31156	Amrit Lal Gupta
31111	Milap Chand Bahl	31157	V. G. Ramachandran
31112	Thottan Lonappan Francis	31158	Bishan Sarup Mittal
31113	Ashok Vinayakrao Nanivadekar	31159	Madan Mohan Sharma

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No.	Name	No.	Name
31160	Vishwanath Prasad Srivastava	31206	Pushpinder Pal Goswamy
31161	Venkatesan Srinivasan	31207	Satya Narayan Prasad
31162	Amarjit Singh Bhatia	31208	Uma Pada Sarkar
31163	Parivakkam Subramaniam Kandaswamy	31209	Ram Bihari Choodhary
31164	Indurai Chhotalal Modi	31210	Jai Dev Kapoor
31165	K. Srikantiah	31211	N. Krishna Sarma
31166	Ram Krishan Tandon	31212	Jaibhuwan Sinha
31167	Jagdish Chandra Katyal	31213	Tirath Singh
31168	Valabhji Ramji Visaria	31214	Jagroshan Lal Jain
31169	Surjeet Singh	31215	Rajeshwar Prasad
31170	Jagdishsingh Dayalsingh Chawala	31216	Paramjit Singh Nanra
31171	Vijaykumar Balkrishna Tendulkar	31217	Kulwant Singh
31172	Ramesh Chandra Verma	31218	Ved Parkash Bansal
31173	Satish Chandra Govil	31219	Rabinder Nath Saini
31174	Alle Narayana Reddy	21220	Sant Ram Bhardwaj
31175	Sarwan Singh	31221	Gursewak Singh Cheema
31176	Nariman Noshir Karanjia	21222	Jai Bahadur Singh
31177	Sudershan Kumar Gupta	31223	Dipok Kumar Bhattacharjee
31178	Darshan Singh	31224	Bihari Lal Gupta
31179	Surjit Krishan Awasthee	31225	Om Parkash Satya
31180	Rajeshwar Kumar Gupta	31226	Niharendu Sarker
31181	Chalicham Lakshmikanthaiah	31227	Ved Kumar Manchanda
31182	Vikramjit Singh Sapra	31228	Kuldip Singh
31183	Subas Kumar Pal	31229	Kewal Kumar Gupta
31184	Gurdip Singh	31230	Parduman Singh
31185	Narinder Mohan Ghai	31231	Gurcharan Singh Bharara
31186	Gantayat Parida	31232	Roop Ram Nagar
31187	A. Narayanan Kutty	31233	Dharam Pall Sawhney
31188	Hardam Singh	31234	Jagjot Singh Mokha
31189	Paresh Chandra Mukherjee	31235	Jagdish Chander Bhatia
31190	Bhagwan Dass Malhotra	31236	Satya Paul Verma
31191	Sewarnjit Singh	31237	Mahesh Chandra Singh
31192	Narendra Kumar Jain	31238	Pramod Behari Saran
31193	Sailendra Kumar Datta	31239	K. Padmanabh Bhat
31194	Prem Nath Singal	31240	Rajendra Kumar
31195	Amitava Basu	31241	Bhupendra Kumar Bhowani
31196	Harbans Lal Malhotra	31242	Om Prakash Goel
31197	Jiwan Parkash Kapoor	31243	Rajeshwar Chander Sharma
31198	Baldev Singh Bansal	31244	Nalini Ranjan Prasad Sinha
31199	Harbans Singh Dhillon	31245	Gurbax Singh Dhariwal
31200	Man Mohan Krishan	31246	Tej Prakash
31201	Zora Singh Sohi	31247	Mahavir Partap Singh
31202	Sitangsu De	31248	Brindaban Mohan Ganguly
31203	Ashok Kumar Gupta	31249	Ajoy Kumar Bahadur
31204	Abnash Singh	31250	Bharat Bhushan
31205	Atma Ram Kanda	31251	Prem Kumar Sharma

STUDENTS (*contd.*)

No.	Name	No.	Name
21252	Om Prakash Gupta	31264	Gurjanak Singh Soin
31253	Hari Chand Mehta	31265	Mangat Rai Singla
31254	Markandey Singh	21266	Ishar Singh
31255	Gangadhar Mojilalji Patne	31267	Dalbir Singh
31256	Mihir Sadhukhan	31268	Om Parkash Bhagi
31257	Narendra Kumar Jain	31269	Jagjit Singh Dasan
21258	Vijay Kumar Gupta	31270	Charanjit Singh Bais
31259	Gopiballav Prasad Srivastava	31271	Hari Chand Saini
31260	Bishwa Nath Chatterjee	31272	Dharam Pal Blassi
31261	Samar Sen	31273	Kesho Ram Jain
31262	Balbir Singh Chauhan	31274	Jasmel Singh
31263	Joginder Singh Kohli	31275	Om Parkash Arya

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here

Lt.-Col. S. E. C. Vas

Lt.-Col. S. E. C. Vas, B.Sc.(Eng.), M.I.E., died on January 23, 1962, at the age of 56.

After obtaining the School Leaving Certificate from the Madras University in 1925, Shri Vas continued his education in Edinburgh, Scotland, where he obtained the B.Sc. (Eng.) degree of the University of Edinburgh in 1931. He worked as Engineer and Junior Partner in Isaac Bros., Automobile and Mechanical Engineers, till 1936. He was Assistant Electrical and Mechanical Engineer in the Government of Burma from 1936 to 1940. He joined the Indian Army as Ordnance Mechanical Engineer in 1940 and was given a permanent commission as Electrical and Mechanical Engineer in 1943.

Shri Vas joined the Institution as Member in 1949.

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In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

ELECTRICAL ENGINEER, passed all-India (national) diploma (full time course) in electrical engineering of the All-India Council for Technical Education in 1949 (recognized as equivalent to engineering degree), A.M.I.E., with three years experience in drawing/design, six years experience as university lecturer teaching diploma and degree classes, and four years experience as Principal in an industrial training institute, organizing training programmes, purchase of equipment for polytechnic, and head of the department of electrical engineering in a polytechnic; holding class I senior post; age 32 years; seeks change in Government or private organizations. Salary expected Rs. 1,000. (Office ref. E.S. 103)

ELECTRICAL ENGINEER, B.Sc., L.E.E., age 28, four years experience in electrical engineering seeks immediate employment, preferably in chemical factory in Bombay. (Office ref. 104)

STUDENT of the Institution of Engineers (India), age 22, appeared for Section A of the Associate Membership Examination of the Institution, more than 1½ years experience in rail straightening (production work) in a leading Government steel plant, seeks technical or non-technical post in Calcutta or outside. (Office ref. E.S. 105)

THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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Civil Engineering Division part	*CI*	6	CI_3		CI_4		CI_5		CI_6		CI_1		CI_2	
Mechanical Engineering Division Part	*ME*	6	ME_3		ME_4		ME_5		ME_6		ME_1		ME_2	
Electrical Engineering Division Part	*EL*	6		EL_3		EL_4		EL_5		EL_6		EL_1		EL_2
Electronics & Telecommunication Engineering Division Part	*ET*	3	ET_2				ET_3				ET_1			
Chemical Engineering Division Part	*CH*	3		CH_2				CH_3				CH_1		
Mining and Metallurgy Division Part	*MM*	3			MM_2				MM_3				MM_1	
General Engineering Division Part	*GE*	3				GE_2				GE_3				GE_1
Hindi Section	*HI*	3				HI_2				HI_3				HI_1

Figures appearing as subscripts indicate issue numbers.

* A new volume commences in September each year and ends in August next year.

Only members who have returned the publication distribution card (attached for the first time in May 1961 *Bulletin*) indicating the Journal Division Part of their choice will receive copies of that Part without payment.

PROFESSIONAL STANDARDS AND EMPLOYMENT CONDITION

Dr. T. Sen
Member

Present situation

The expansion of engineering from its beginning in military and civil engineering a century ago to a multiplicity of disciplines today has created a host of problems. Of major concern to the engineer is his relationship as a professional man with his employer. This relationship is influenced largely by employment conditions, including salaries, training programmes, security policies, levels of responsibility, job classifications, and identification with management.

Because the needs, responsibilities and contributions of professional employees have not been recognized adequately in some instances, there has been a movement toward unionization of engineering personnel. This has had an adverse affect on the professional concepts of many engineers, for a professional man must rely primarily on his own personal competence and integrity for recognition. In addition, confidential relationships which should exist between employers and professional engineers have been jeopardized.

The fact that there has been a trend toward collective bargaining by engineers, in spite of widespread reluctance to participate in such action, indicates the existence of unsatisfactory conditions. The engineering profession and management have a great stake in the solution of the problem, and the latter must accept its share of responsibility for alleviating unfavourable employment conditions.

The causes for this condition

The reasons which have fostered collective bargaining among engineers may be grouped as below.

1. *Professional treatment*
    - (i) A feeling among engineers that they are not identified with management, whether they are employees in industry, private engineering firms, or the public service ;
    - (ii) Inadequate channels of communication between top management and non-supervisory engineers ;
    - (iii) Inadequate recognition of the engineer as a professional employee ;
    - (iv) Assignment of engineers to sub-professional work ;
    - (v) Undue retention of engineers in specialized and narrowly compartmentalized assignments ; and
    - (vi) Lack of appropriate means for resolving individual problems.
2. *Personal treatment*
    - (i) Inadequate recogniton and treatment of the engineer as an individual ;
    - (ii) Lack of broad position classifications and appropriate titles by which the engineer could measure his progress ;
    - (iii) Inadequate or non-existent plans for training and job rotation ;

(iv) Inadequate understanding of promotional policies and belief that progress and promotions were not commensurate with ability and performance ;

(v) Feeling of insecurity of employment ; and

(vi) Management's human relations knowledge has not kept pace with the expanded utilization of engineers.

3. *Financial treatment*

(i) Engineer's salaries not commensurate with fundamental contribution ;

(ii) Too small a differential between the pay of an engineer and a member of the skilled trades ;

(iii) Salaries of experienced engineers not sufficiently increased in comparison with the present starting salaries ;

(iv) Wide variation in salaries paid to engineers doing comparable work in different organizations ; and

(v) Dissatisfaction with the merit review systems and inadequate understanding of salary administration.

Faced with these conditions, some engineers have resorted to unionization in the belief that corrective action could be effected only by exerting pressure on management through collective bargaining. Though these engineers may have realized that professionalism requires freedom of action, they appear to be willing to submerge this principle in their attempt to get more pay and better working conditions through union activities.

To obtain reliable statistics regarding the current status and thinking of a cross-section of the engineering profession, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the Society of Naval Architects and Marine Engineers collected the opinion of 117,917 of their members on specific questions concerning collective bargaining. Of these, 57% or 66,938 members responded. Returns showed that 72% or, 48,082 out of the 66,938 respondents opposed collective bargaining for professional engineers, and 66% (or, 44,168 members) felt that collective bargaining is incompatible with professional status. The response further showed that less than 4% were actually members of established collective bargaining groups, 27% reported that they were not opposed to collective bargaining, 20% reported that they believed collective bargaining would be advantageous to them, and less than 1% of the membership of the first three societies (the fourth did not ask the question) reported that they would prefer to be represented by a craft labour union.

These results present a challenge to the engineering profession and to the management. The thinking of the remaining 43% of the members polled who did not respond to the questionnaire is still unknown, but, assuming that the sample was representative, there would then be 30,300 members who are not opposed to collective bargaining for professional engineers.

The problem and suggested solutions

A summary of the above leads to two basic reasons for the present situation :

(i) Engineers have not always realized and understood the professional characteristics of their roles ; and

(ii) Management has not always realized and accepted its obligations to engineers.

If these are the causes, the problems may be stated as (i) how to get the engineer to appreciate the professional characteristics of his position? and (ii) how to get the management to realize and accept its obligations to its engineers?

The solutions to these problems may be listed under five main headings :

(i) Point out to the engineer and re-emphasize to him that engineering is a profession and, therefore, he has certain definite responsibilities.

(ii) Point out to the management, through all feasible ways, that it has responsibilities to the engineering profession.

(iii) Point out to the professional societies such as the Institution of Engineers (India), the part which they should play in the advancement of the profession.

(iv) Point out to engineering educators their responsibilities for developing professional concepts in students.

(v) Point out to society the contribution of the engineer to its general welfare.

Engineering—a profession

Engineering is the art and science by which the properties of matter and energy are made useful to man in the form of structures, machines and other products. Accomplishment of these requires not only scientific training but also creative imagination, judgment, and an appreciation of the economics involved. The work of the engineer is predominantly intellectual and varied. The dictionary defines engineering as a mental activity rather than a manual skill. The engineer must exercise discretion and judgment, he must wish to serve, and his relationship with management must be one of confidence ; in fact, he is a part of the management. The engineer is charged with the protection of public health and safety. The builder of a bridge, an aeroplane, a water supply system, a dynamo, a kitchen range, an automobile or a chemical plant must be also concerned with its safe operation. Responsibility rests upon his shoulders ; if he does not accept that responsibility, he is not professional.

Every profession requires knowledge and skill of a high order, and also requires that the practitioner in that profession should work in an atmosphere of confidence. In the field of administration, medicine and law, this relationship is usually on an intimate personal basis, but, in engineering, it usually is more general and involves obligations to the public at large as well as to the employer or the client. The engineer's code of ethics requires that 'he will have due regard for the safety of life and health of the public and employees who may be affected by the work for which he is responsible' and that 'he will act in professional matters for each client or employer as a faithful agent or trustee.'

Since clients and employers usually do not have the technical knowledge necessary to judge technical work, the engineer is bound to place their protection above his personal convenience or his immediate personal gain. A fundamental principle of professional responsibility is trusteeship. This is also a fundamental principle of management. To the employed engineer, this means that the professional attitude involves a 'management-oriented' point of view.

Engineering operations today are varied and extensive. Men at all levels of training and competence are required to carry out vast engineering enterprises. The work of the draftsman, the layout man, the toolmaker, or the plant operator is indispensable, but does not require the imagination, educational background, or, judgment of the engineer who conceives and executes the broader aspects of the projects.

The work of a truly professional engineer is so distinct from a routine and established pattern that only he can provide the initiative, discretion and judgment to achieve the successful accomplishment of his particular task. Since the professional engineer alone knows with what comprehension, ability and likelihood of success he approaches his assignment, he must accept individual responsibility or else advise his client or employer that other help is needed.

Professional attitude involves the following five basic concepts :

(i) A social consciousness, a desire to contribute rather than simply to benefit from the civilization, and a resolve to place the public welfare above other considerations ;

(ii) The acquisition of special skills on a high intellectual level, generally evaluated by means of self-imposed standards of excellence ;

(iii) A sense of trusteeship—personal responsibility to protect the client's or employer's interests ;

(iv) Individual initiative and acceptance of individual responsibility, both of the highest order ; and

(v) A right to expect and receive adequate financial recognition.

Prestige, however, is something that must be won. It cannot be bought or automatically accorded through affiliation with an organization. It is something that one can command but never demand. In the final analysis, an engineer achieves professional standing only to the extent that he accepts his responsibility to himself, to his client or employer, and to society.

Attainment of a degree in engineering from an institution of recognized standing implies that the graduate has mastered a certain curriculum and that he has the ability to understand, assimilate and apply the knowledge that qualifies him to become a member of the engineering profession.

Although social consciousness is not necessarily a corollary to superior mental competence, most people who are endowed with such competence have a sense of responsibility to the social order of which they are a part. They have learned to look on life as an opportunity to contribute to the civilization that fostered them and thus to better the lot of those who follow. To the engineer who feels that life provides opportunities for constructive contribution to society, collective bargaining with its attendant potentiality for creating conflicting obligations is not acceptable.

Employee's responsibilities in the engineering profession

'As an engineer, I will participate in none but honest enterprise. To him who has engaged my services, as employer or client, I will give the utmost of performance and fidelity.' (*Faith of the Engineer*)

The engineering employee is bound by the same ethical and moral principles that apply to a member of any other learned profession. The responsibilities of an engineering employee are many. He is obliged to perform the professional assignments entrusted to him to the best of his knowledge and ability. He should give the needed professional counsel in his special field and render loyal service. He should respect the economic problems of his employer. He should be thorough, expeditious, original, and accurate in the execution of his duties and assignments. He should have a rational attitude towards his work and fulfil each task with minimum supervision. At all times, he should strive to improve the quality and increase the quantity of his output.

Education is important to the engineer and he should foster its continuance for those who are subordinate to him. He should strive to recognize and utilize the diverse capacities of his fellow employees. He should strive for good planning and clear and concise reports. He should be friendly and maintain good appearance. He should develop the ability to be a good listener and able to express his thoughts effectively.

It is axiomatic that just as management has responsibilities to its employees, the employees have responsibilities to the management. The engineer employee should realize that he is not just another hired hand. He should know that to achieve full professional stature, he must develop himself to rise above the technical or engineering assistant. He must have genuine desire to expand his capacity to extend his knowledge and improve his proficiency.

Any employee who is unwilling to assume responsibilities beyond those accompanying his present job has little right to be critical about lack of advancement. If he feels that he is not getting earned recognition, it may be that critical self-appraisal is in order. One cannot just wish himself up the ladder or depend on someone else to push or pull him along the way to success. The fact that a man has acquired a bachelor's degree in engineering does not of itself entitle him to any lasting professional recognition. It remains for each individual to prove by his own ability, integrity and conscientious application to duty that he deserves recognition.

Management's responsibilities in the engineering profession

Management must recognize the inherent professional character of engineering work. It should be a policy of the management to use its professional employees to the maximum of their capabilities. Except during the training period, the engineer should not be assigned tasks which do not require his technical training, and he should be accorded individual and professional status commensurate with the quality of his contribution.

There must be opportunitits for continuation of education. It is important that professional employees be given opportunities to participate in the activities of scientific and technical societies. It is also important that they should receive credit for their contribution to the advancement of technical knowledge of the profession.

There must be adequate communication between the management and the professional employee. There should be organized orientation and training programmes for new employees. Engineers need to understand the basic policies of their employers, and know their responsibilities and opportunities for advancement. Adequate management-employee communications require a day-to-day relationship supplemented by periodic performance reviews and other appropriate techniques.

Such salaries should be offered which will recognize the contribution of the professional employees as related to those of the other groups. Salary differentials between various levels of technical experience have been substantially narrowed during recent years. Engineers who, after a period of satisfactory employment, find their salaries are only slightly higher than those of fresh graduates and possibly lower than those of a skilled craftsman, are not working in a favourable atmosphere.

Management must minimize the fear of job insecurity by adopting feasible means for stabilizing the employment of professional personnel and developing suitable policies for termination of services. Since many engineers later become managers, there is a need to ensure that they are employed and developed in an atmosphere which enables them to carry their future responsibilities. Executive talents must be developed by experience and training in those phases which lead to managerial responsibilities.

Engineering societies' responsibilities in the engineering profession

The engineering societies must take the lead in the advancement of the profession. Among the basic responsibilities of the engineering societies are the establishment of standards of ethical conduct, rigid requirements for admission to membership, accreditation of educational institutions which grant engineering degrees, and awards and prizes in recognition of worthy contributions to the advancement of the profession.

A national engineering society like the Institution of Engineers (India) has the additional responsibility of fostering a healthy professional climate for employed engineers. Their governing boards and individual members should unite in exerting utmost efforts towards solving the problem. These responsibilities are so challenging and vital that they must be considered as obligations.

Efforts to encourage professional development of the members and to promote recognition by the public of the professional character of the engineers' work should be expanded. An objective evaluation of the problem should be continued, followed by specific recommendations for the good of the profession. Engineering societies should adopt official statements for membership information with respect to collective bargaining to the extent permitted by their charters and constitutions. They should acquaint their members with those provisions of the Factory and other Acts which have a special significance to professional engineers. Constructive programmes for encouraging professional consciousness on the part of engineers, both before and after graduation, should be sponsored. They should inform management as to the standards that will contribute to full professional achievement.

The engineering societies should provide guidance and assistance to educational institutions confronted with problems detrimental to the achievement of full professional training for students.

Engineering educator's responsibilities in the engineering profession

Engineering colleges have the primary responsibility of developing professional concepts in engineering students. These concepts should be developed through their application to the solution of engineering problems in the technical courses by lectures, by association with other students, and by good examples.

Opportunities for engineering educators to become better acquainted with the total environment in which engineers' work should be expanded through temporary employment in non-academic field and the utilization of employers with 'professional vision' in classrooms and student seminars. Such activities enable students to appraise their status more realistically after graduation.

Conclusions

There are obligations and responsibilities resting on both the employer and the employee. Each, of course, has responsibilities to advance his own welfare. Beyond that, and yet a part of it, each has responsibilities towards the other and to the society. Responsibilities for inculcating and developing professional consciousness in young members of the profession rest upon educational institutions and professional societies.

Without a sound technical foundation, no man can become a competent engineer. But more than technical competence is demanded of one who expects to be recognized as a professional person. He must understand and observe appropriate ethical standards. It is important to cultivate proper understanding of such standards.

There are opportunities for the engineering societies, colleges, industrial management and civic institutions to work together to help young graduates in continuing their education and adjusting themselves to the conditions to be met in the practice of their profession. Concerted efforts by all concerned with the advancement of the profession are required if satisfactory solutions are to be found.

I would therefore plead that

(i) Management should utilize the services of engineers more effectively and thereby afford them opportunities for advancement and economic improvement ;

(ii) Management should recognize its responsibility to make engineers feel that they are a part of the management ;

(iii) Management should survey areas of communication, recognition of salaries and, where found wanting, correct them to conform to the standards of professional practice ;

(iv) The engineer should take inventory of his services and actions to make sure that he has a professional attitude toward his work ;

(v) The Institution should establish and employ appropriate means to maintain high standards of ethical conduct for professional achievement ;

(vi) The Institution should encourage the professional development of their members and promote proper recognition of the profession ; and

(vii) Engineering educators should emphasize the characteristics of the profession.

FREEDOM OF SPEECH

B. Seshadri

Member

Our Constitution guarantees freedom of speech and expression. There is plenty of evidence—one needs only to look at the tabloid newspapers—that this freedom is generously taken advantage of. But there is one fraternity of rather important people who are deadly scared to make use of this privilege. These are the engineers.

Engineers in India are perhaps no worse off than their fellows in most other countries of the free world, the U.S.A. certainly excepted where it is said that an engineer can walk out of his job one morning and walk into another the same afternoon.

Why, then, are the engineers so tongue-tied? The reason is not far to seek. The vast majority of them are employed by government (Central and States), municipalities and other local authorities, nationalised corporations, engineering universities and colleges, foreign companies, and newly big industrial groups. Which amongst these will tolerate the engineer who speaks his mind? No engineer employed by any of these groups ever feels free to exercise the right of freedom of speech on a question even distantly connected, say, with a controversial topic or his employment. If he does, the consequences are grave and untold. I know of a case or two who were the rare exceptions—they were very brave men and, like all very brave men, suffered the consequences, which were not pleasant. Not all of us are of that mould.

No statistics exist or can be had of the percentage of the total number of engineers in the country in the employ of the above groups of organizations, but certain it is that the figure is very high, no less than at least three-quarters of the total. The very human being that he is, the engineer has to think of his responsibilities—the family, and, in India, sometimes (rather often) this extends well beyond his wife and children—and, to think of his responsibilities is to think of his advancement. This thought is about the most effective gag to any rebellious thought to exercise one of the fundamental freedoms.

Let us then look at the lucky minority who, we have tacitly assumed, are in a position to speak up—about themselves and about the profession. There is no doubt, on the whole, they are better placed to put their thoughts before the public. But it is seemingly absurd that this minority is even less voluble than their gagged colleagues in the majority group. Why? Simply because they are often only answerable to themselves, else they are in small units where they are already sufficiently important, that they have little need to air their problems in the murky, smoke-laden atmospheres of the big cities, from where generate the great dailies with their many columns devoted to 'Letters to the Editor'.

The profession of engineering in India, thus, is one in which three engineers out of every four are 'cogs in the wheel', with the fourth part not very interested in being articulate. The engineer is thus part and parcel of the organization which employs him, and cannot, therefore, criticise or comment except at his peril. If he strove in any other direction except that prescribed by his employer, he will be answerable to the hungry mouths he has to feed. The occasional rebel who makes the mistake of assuming he is voicing the views of others working with him should be prepared to accept he may have committed a gross error of judgment, because when he is in trouble, he may find himself very much alone—so soul-destroying are the economic circumstances.

Pepper in the stew? Did the voice at my elbow whisper I am needlessly pessimistic? If the same voice would inject optimism into me (while I am fully awake), a fabulous welcome awaits it.

The engineer may not know how to defend himself, but he is not truly denuded until he no longer knows what is happening to him. The trouble, in India, is that he knows. Somebody—I cannot recollect who—once wrote (or words to this effect) that no one's lot is worse than his who has to stand by and see things going wrong, without being able to voice his opinion. But what cannot be remedied must be suffered, for not all of us are cast in the heroic mould.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Madhya Pradesh Centre

Chairman's address by Dr. V. M. Dokras, M.Sc., C.I.I.Sc., M.S., Ph.D., M.I.M., M.I.E., at the 3rd Annual General Meeting of the Centre on January 9, 1962.

The Chairman welcomed the Chief Guest, Shri H. V. Pataskar, Governor of Madhya Pradesh, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

During his address, Dr. Dokras spoke on 'rare metals' in the following words:

'Let us consider what is a rare metal. Aluminium, which was so rare that Napolean ordered a dinner service of the metal for his guests, has now become common because of advances in technology. Uranium, of which only a few grams were available as early as in 1940, is now produced in tons. When the natural deposits of the metal in the earth's crust is small or when the metal occurs in fairly large quantities but not in concentrated form, making it difficult to extract the metal from its compounds, or when the metal does not have attractive properties, it is likely to remain uncommon or rare. When one of the above conditions is changed, the metal becomes available for use. The great strides made during the last 30 years in commercial development and utilization of the so called minor metals, heretofore classed as museum specimens or curiosities, have gone hand in hand with development in other fields, notably in the field of vacuum technology for the manufacture of electric lamps, radio tubes, photo-electric cells, mercury arc rectifiers, etc. Next to vacuum technology, demand on metallurgists has been made by building and transportation industries for those metals and alloys which are stronger and lighter, more resistant to fatigue and corrosion, capable of withstanding high temperatures and cheaper than the alloys produced in the past.

Metallurgy had its beginning before the days of ancient Egyptians. For centuries, there were only six recognized metals. Modern technology depends on the use of metals such as iron, copper, aluminium, magnesium, etc. for the fabrication of machines and other instruments of production. Due to the large quantities of these metals required and produced today, little is appreciated about the role of the rare metals. Some of these rare metals not only make the use of the common metals practical, but many times opened a new chapter in technology because of their peculiar properties. The capacity of vanadium to give fine grained steel, columbium to correct intergranular corrosion of stainless steel, tellurium to improve the properties of lead and rubber, tungsten to give tough steels, beryllium to render copper hard and fatigue resistant, germanium and silicon to give transistors, and uranium to make fission possible, are some of the examples.

Mason has made a careful compilation of the average composition of the earth's crust. The order of abundance of the existence metals is silicon, aluminium, iron, calcium, sodium, potassium, magnesium, titanium, manganese, rubidium, strontium, barium, zirconium, chromium, vanadium, zinc, nickel, copper, tungsten, tin, lead, mercury, silver, platinum, gold. The relative abundance of many metals which are not commonly used in large quantities such as titanium, rubidium, zirconium, and vanadium is noteworthy. Copper, zinc, tin and silver, though occuring very low in the list, play important roles in civilization. With the help of high temperatures available in electric furnaces, the clean and convenient method of induction heating and the efficient and controlled oxidation and reduction by electrolysis at relatively low temperatures, it has been possible to evolve products not possible by non-electrical methods. Demand for raw materials making these phenomena possible has made chemists, geologists, minor prospectors and explorers all over the world to locate deposits of rare metals of commercial importance.

It is not possible to give even a survey of the total field of rare metals technology, and I have selected a few typical cases for the development of our technology.

Amongst the alkali metals, lithium is the first which is of interest. Its salt, lithium chloride, is important in air-conditioning industry and metallic lithium is used as scavenger in steel metallurgy. 'Scleron' (83% Al, 12% Zn, 2% Cu, 0.5% Fe, 0.6% Si and 0.1% Li) is an important alloy of aluminium and zinc. With 0.1% Li, properties comparable to steel are imparted to this alloy. Potassium photoelectric cells, though not as good as rubidium or cesium cells, are relatively cheap and of considerable importance.

The metals magnesium, calcium, strontium and barium are important. Large scale development of magnesium and its alloys in automative, aeronautical and machine industries is vital to the country due to the shortage of copper and other non-ferrous metals. Zirconium, magnesium and barium are extensively used as 'getters' and are required for the development of the vacuum tube industry. Calcium, which is manufactured by electrolysis of its chloride or by aluminium reduction, is used as an alloying element with aluminium, lead and other bearing metals, as controller of graphitic carbon in cast iron, as carbonizer and desulphurizer for copper, nickel, iron, cobalt alloys, and as reducing agent for production of chromium, thorium, uranium and zirconium. Berylium, which is produced from its chloride, gives the 2.2% Be-Cu alloy which competes with spring steel. In addition to having fatigue resistance equal to steel, it is highly resistant to corrosion and is a fair conductor of electricity. It is widely used in the watch industry and for the manufacture of coiled and flat springs, and wire and strip parts subject to repeated flexures.

Amongst metals of the third group, thallium and indium exhibit interesting properties. Here 25% thallium with lead gives the most insoluble anodes for mineral acid solutions. Indium plated parts have the property of oil retention and are used in automobile engines. Bismuth, which is useful in forming fusible alloys which melt at temperatures as low as 61°C., is used for the preparation of safety devices. It is one of those metals which expand on solidification.

Amongst metals of the fourth group, germanium and silicon are outstanding for their application in electronic equipment, particularly transistor technology. Zirconium alloys are resistant to chemical attack and are used for spinarete cups in rayon manufacture. Of special interest is titanium with its high chemical and temperature resistance and low density. It has opened a new field in jet engineering and armour industry.

Vanadium and columbium of the fifth group are indispensable for the production of steels of fine quality. Vanadium and copper alloys are used in the manufacture of submarine and ship parts to resist corrosion. With aluminium, vanadium gives alloys of high stiffness for aeroplane frames. Use of vanadium as catalyst in chemical reactions is well known.

Amongst metals of the sixth group are molybdenum, tungsten, uranium, selenium and tellurium. The world production of molybdenum is more than 1,000,000 tons. When alloyed with steel, it increases toughness and fatigue resistance ; and with cast iron, it gives a fine structure and improves high temperature strength. Tungsten is used in incandescent lamps and hard tools in the form of its carbide. The technology of uranium is well known. The outstanding development in selenium technology is its application to photoelectric cells of the cuprous oxide type. These cells are based on the electron emissivity of a thin film of selenium exposed to light. Tellurium is used in vapour form in tube lamps. Ionized tellurium vapour radiates light similar to daylight with continuous spectra.

Cobalt in the eighth group gives an alloy with chromium and tungsten, called 'stellite', which is most suited for cutting tools. Another recently developed alloy is the strongly magnetic, aluminium-nickel-cobalt-iron alloy called 'alnico.' Cobalt is also used as cement for tungsten carbide.

These are some of the important technological properties of some of the rare metals, which are essential to build up modern technology, though required in small quantities.

One of the main features of the industrial programmes in the Third Plan is the development of the metallurgical industry. The target for the production of steel is 10,200,000 tons. The total annual production of finished steel is expected to steadily rise from 3,500,000 tons in 1961-62 to 6,800,000 tons in 1965-66. It is estimated that 75,000 tons of spring and free cutting steels and 70,000 tons of electrical steel will be required during 1965-66. The Alloy and Tool Steel plant at Durgapur will have a capacity of 48,000 tons with rapid expansion facilities to 100,000 tons per annum. The serious problem of the current demand for imports of high price but essential raw materials of the engineering industries has been realized. The targets for the production of aluminium and copper have been placed at 87,500 tons and 11,500 tons per year, respectively. The Zawar mines of Rajasthan are expected to produce 15,000 tons of zinc by 1965. In addition, the manufacture of plants for different industries will require large amounts of castings and fabrications, depending on the alloys produced. These alloys must have one or more rare metals in small percentages to give the required properties.

A survey of the work done in the country in the field of rare metals shows that except for isolated workers in different laboratories, nothing is being done and the bulk of the requirement of these metals is being met through imports. This is not desirable, particularly because we are trying to build our automotive, aircraft, armament and engineering industries. Our resources of these metals are unknown and it is necessary to undertake this work also as a part of national plan. One method of doing this is the establishment of a National Institute of Rare or Uncommon Metals. This Institute should have the following divisions: (i) geological, (ii) chemical, (iii) physical, (iv) mechanical and fabrication, and (v) electrical. The Institute, should have as its objectives

(i) Assessment and evaluation of the requirement of different metals and their compounds ;

(ii) Geological exploration and evaluation of these for economic utilization ;

(iii) Beneficiation of ores, preparation of different pure compounds and ultimate winning of the metal ;

(iv) Research and study of alloys, and their electrical, mechanical and chemical properties ; and

(v) Metallurgical treatment and fabrication.

The Institute must have all the facilities for achieving its objectives and a staff interested in the work.

The future of our economy depends on increasing the means of production, and metals and alloys are the main constituents from which these means can be fabricated or constructed. Every aspect of development of metals technology has, to be assured, and here the Institute can play a vital role.

It is only by undertaking such a planned programme that we shall be able to cover the ground and be able to meet the requirements of the ever increasing industry.'

Rajasthan Centre

Chairman's address by Shri K. N. Bhargava, B.Sc., C.E., M.I.E. at the 3rd Annual General Meeting of the Centre on January 17, 1962.

The Chairman welcomed the Chief Guest, Shri Ram Kishore Vyas, Home Minister Rajasthan, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

Delivering his address, Shri Bhargava gave a brief review of the engineering activities and developments in the State as follows. 'The State has completed two Five Year Plans and has started implementing the Third Plan. While other States were engaged in implementing the First Plan, Rajasthan was busy in organizing a stabilized administrative set-up, financial integration and setting up of efficient machinery to maintain law and order. The first two years of the First Plan passed in these preliminaries and the development actually started in the third year. The total expenditure during the First

Plan amounted to Rs. 51.14 crores, including the centrally sponsored schemes. During the Second Plan, departmental machinery was geared up and there was great uplift in economic and social developments. The two main objects, enhanced production and increased employment, were pursued. The total expenditure during the Second Plan amounted to Rs. 123.27 crores. The remarkable feature of this Plan has the introduction of *Panchayat Raj* in the State. Thus, the Third Plan was made a real beginning towards the process of planning. The allocation during the Third Plan has been kept at Rs. 236 crores, excluding the amount to be allocated for centrally sponsored schemes.

The results of planned development in Rajasthan are visible in the various sectors of development, and a few of these are explained in the following paragraphs.

Panchayat Raj

The introduction of *Panchayat Raj* in the State in the year 1959 was an event of great significance.

Agriculture

Agriculture is the most important enterprise in the country. Today, as a result of progressive land reforms, cultivators are generally the owners of land and have every incentive to pursue their work enthusiastically and increase the yield.

Irrigation

Irrigation facilities have been extended through the construction of a number of major, medium and minor irrigation works. The net irrigated area increased from 2,488,000 acres in 1951-52 to 3,335,000 acres in 1955-56 and 3,571,000 acres in 1958-59. The net sown area increased from 28,303,000 acres in 1955-56 to 31,104,000 acres in 1958-59. As a result of land reforms, increase in irrigation facilities and adoption of improved agricultural practices, the State has not only attained self-sufficiency in foodgrains but also a sizeable surplus.

Education

Spectacular progress has been made in the field of education. The recent census indicates that literacy has increased to 14.66% in 1961 from 8.95% in 1951. Similar is the case in technical education. Industrial Training Institutes have been established at 17 places in the State. Besides expanding two degree colleges, six new polytechnics have been established. It is proposed to expand technical education further by starting a Regional Engineering College at Jaipur and to increase the intake of the existing colleges at Jodhpur and Pilani. Post-graduate classes are also proposed to be started in the two existing engineering colleges. Two new polytechincs, at Bharatpur and Jaipur, have been proposed. Technical education has, thus, been promoted with a sense of keenness and urgency. The establishment of engineering colleges, polytechnics and industrial training institutes are some of the steps taken by the state Government to meet the requirements of trained and qualified personnel.

Roads

Formerly, a number of district headquarters were not connected by roads. The regimented planning has witnessed considerable expansion in road mileage, and now almost all the tahsil headquarters are connected by roads. The road mileage has increased from 11,371 in 1950-51 to 13,988 in 1955-56 and 16,744 in 1960-61.

Power houses

In 1951, there were only 32 power houses. Their number increased to 54 in 1960. The per capita generation of electricity increased from 3.59 kWh in 1951 to 3.99 kWh in 1955 and 5.47 kWh in 1960. The installed capacity at the end of the Second Plan was 110,000 kW, and in the Third Plan, it is likely to increase to 334,000 kW. Now 131 towns and villages are electrified and many more will be electrified in the near future, as the network of hydro-electric power stations spreads through the completion of the Bhakra and Chambal projects.

Industries

Though the State is rich in raw materials and mineral resources needed for industrial development, yet it was industrially backward for want of cheap power, means of communication and trained manpower. Today, with the increased facilities of water and power, development of communications, provision of financial aid through loans and grants, provision of technical training, liberal concessions to industrial enterpreneurs and promotion of handicraft and cottage industries, the State stands at the threshold of an industrial era. Some of the important industries which deserve special mention are (i) the fertilizer factory at Hanumangarh, (ii) the zinc smelter plant near Udaipur, (iii) the nylon factory at Kota, (iv) the calcium carbide, P.V.C. and caustic soda plant at Kota, (v) the rayon tyre cord plant at Kota, and (vi) the cement factory at Chittorgarh.

The fertilizer factory is expected to go into production by the middle of 1965 and the zinc smelter plant early in 1964. The nylon factory is ready and expected to start working in full capacity by March 1962.

Besides, three additional textile mills at Kishangarh, Bhilwara and Bhawanimandi, are under erection. Another textile mill has recently been licensed by the Government of India for Bijainagar.

Other major industries which are scheduled to come up within the next two or three years are: (i) the scientific and surgical instruments factory at Ajmer, (ii) the woolen mills at Jaipur and Jodhpur, (iii) the oxygen and acetylene gas manufacturing plant at Jaipur, (iv) the wool tops and woollen felts factory at Kota, (v) the extrusion press at Kota, (vi) the chip board plant at Banswara, (vii) the straw board plant at Kota, (viii) the fractional h.p. motors manufacturing industry at Dholpur, (ix) the electrical porcelain insulator manufacturing plants at Jaipur and Kota, (x) the electrical cable factory at Jaipur and at Kota, (xi) the paper mill at Jaipur, (xii) the glass wool and glass fibre factory, and (xiii) the roller flour mills at Jodhpur, Pali and Udaipur.

Besides these, a factory producing pesticidal formulations has already started functioning at Udaipur.

In addition, some existing industrial undertakings such as the National Engineering Industries, the Man Industrial Corporation, and the Jaipur Metal and Electricals, Ltd. have been granted expansion licenses for the manufacture of new products or for increasing their installed capacity. The items of new manufacture include roller bearings, axle boxes, steel balls for bicycles, high tension transmission towers, and A.C.S.R. and all-aluminium conductors.

In the public sector, the Government of India have decided to set up a precision instruments factory at Kota with Russian collaboration. A copper smelter plant at Khetri and a pilot plant for the recovery of sodium sulphate from brine at Deedwana are also being set up.

Public health engineering

Water consumption of a country is an index of its civilization. The position in our country is far from satisfactory. Only 60% (33.7% partially and 26.3% adequately) of the urban population is provided with protected water supply, and only 31.8% (20.6% adequately and 11.2% partially) with sewerage. In Rajasthan, only 45% (27% partially and 18% adequately) of the urban population is provided with water supply and 18% (partially) with sewerage.

First Five Year Plan

Urban schemes

Drinking water supply has been a difficult problem in the State, both in urban and rural areas. Prior to the integration of the covenanting States, protected water supply existed only in Jaipur, Jodhpur, Kota, Bikaner and Dungarpur. With the gradual increase in population and the rising standards of living, even the Government owned water supply schemes were rendered out-of-date. In 1950-51, skeleton water supply schemes were taken up for supply of water through public standposts for 17 municipal towns. This idea became so popular that the demand for comprehensive water supply schemes increased and the State Government sanctioned several schemes out of their funds. In the meantime, the National Water Supply and Sanitation Plan was launched by the Ministry of Health, Government of India, and 14 schemes were sanctioned under this programme at a total estimated cost of Rs. 280.46 lakhs. Besides, eight schemes were sanctioned by the State Government at an estimated cost of Rs. 74.58 lakhs.

By the end of the First Plan, out of the 35 municipal towns having a population of 10,000 or above, only Jaipur, Jodhpur, Bikaner, Kota and Deedwana had protected water supply; Udaipur and Dungarpur had partially protected water supply; eight other towns had skeleton water supply and the rest had no arrangements of safe water supply. The 22 schemes, which were started during the First Plan period, had not been completed and had to be continued in the Second Plan.

Rural schemes

The problem of potable water supply in rural areas demands immediate attention. In some parts of the State, the subsoil water table is as low as 350 ft. and the quality of water is so brackish that it is unsuitable for drinkings. The nature of subsoil strata is different in various parts of the State. After the formation of the Rajasthan State, the Government of India provided a grant of Rs. 125 lakhs to the State Government for water supply schemes in rural areas. Initially, the *Panchayat* department was entrusted with the construction of wells, etc. Under this scheme, about Rs. 20 lakhs only could be utilized during the period of 3-4 years. Later, the work was entrusted to the Rajasthan Jal Board and a sum of Rs. 98.38 lakhs was spent on rural water supply schemes during the year 1955-56. The works undertaken by the Board included repairs to old wells and tanks, construction of new wells, conversion of step wells into draw wells, etc. Towards the end of the First Plan, Rs. 32.96 lakhs were spent on rural water supply schemes on 2,030 such works under the National Water Supply and Sanitation Plan. In spite of the expenditure of Rs. 151.34 lakhs till the end of the First Plan period on rural water supply schemes, the position remained far from satisfactory.

Drainage schemes

Apart from the requirements of adequate supply of protected water, the problem of providing drainage had started receiving attention towards the end of the First Plan period. So long as regular water supply schemes do not exist in a dry place like Rajasthan, unsatisfactory drainage conditions may not prevail, but no sooner regular water supply schemes come into operation, regular drainage schemes must follow immediately. Most of the water supply schemes started during the First Plan period were expected to be completed by the end of the Second Plan. As such, the necessity for drainage schemes could arise only towards the beginning of the Third Plan period.

Second Five Year Plan

During the Second Plan, Rs. 145.96 lakhs were provided for urban water supply schemes, Rs. 195 lakhs for rural water supply schemes, and Rs. 3 lakhs for drainage and sanitation schemes. Besides, Rs. 150 lakhs were provided under the National Water Supply and Sanitation Plan.

Urban schemes

Under the urban water supply schemes, besides continuing work on the 22 schemes which were left incomplete at the end of the First Plan period, 42 new schemes were provided under the State Plan. 27 schemes were completed by the end of 1961, and 19 other schemes are expected to be completed by 1963-64. Under the new schemes, water works have been constructed on behalf of municipal boards by the Government and necessary funds have been advanced as loan irrespective of the size of the town. All the water works in the State were run and managed by the Government and the metering system for the supply of water was followed. On these schemes, Rs. 349.23 lakhs were spent under the State Plan. Besides, Rs. 261.48 lakhs were spent under the National Water Supply and Sanitation Plan. These efforts have resulted in bringing water to the scarcity areas. In Jodhpur, water has been brought from a distance of 100 miles from the Jawai tank after pumping through seven stages. In the desert areas of Jaisalmer and Barmer Districts, with the help of the Exploratory Tube-Well Organization, it has been possible to locate sweet water at a distance of about eight miles from Jaisalmer and 19 miles from Barmer. The activities under the Plan have made protected water supply available to 27 towns in the State.

Rural schemes

At the beginning of the Second Plan, the schemes started under the National Water Supply and Sanitation Plan were continued by the Board, and in 1956-57 2,200 works were undertaken. Later, the implementation of the rural water supply schemes was entrusted to District Collectors through the District Development Committees.

With the introduction of democratic decentralization, execution of rural water supply schemes was entrusted to *Panchayat* Samities, but the execution of piped water supply schemes remained with the Department. By the end of 1961, Rs. 182.22 lakhs were spent on rural water supply schemes. Besides, such works were also undertaken by the Development Department through the Development Blocks and by the Social Welfare Department for the benefit of the scheduled and backward classes.

Drainage schemes

The work on drainage and sanitation schemes was started only towards the end of the Second Plan period. By the end of 1961, Rs. 1.85 lakhs were spent on these schemes.

Third Five Year Plan

In the Third Plan, a provision of Rs. 500 lakhs has been made for urban and Rs. 200 lakhs for rural water supply schemes. An important scheme for Ajmer, estimated to cost Rs. 220 lakhs, has been taken up in which water is proposed to be brought from the Banas River at a distance of 70 miles from Ajmer where the Irrigation Department proposes to construct a dam. Water will have to be pumped in a number of stages against a static head of about 800 ft.

Piped water supply schemes are proposed to be taken up in about 60 villages where scarcity conditions prevail. In rural areas, construction of new wells, repairs to old wells and conversion of step wells into sanitary wells will also be taken up at a cost of about Rs. 100 lakhs.

Management of water works

In Rajasthan, water works in the big cities such as Jaipur, Jodhpur, Udaipur, Bikaner, Kota, and Dungarpur are owned and managed by the Government. At other places, the water works were constructed by the Department on behalf of the Municipal Boards, but the Municipal Boards were reluctant to take them over as qualified and trained staff was not available with them. As an experimental measure, these are now being run by the Department on behalf of the Municipal Boards after associating the Boards concerned in their management. So far, this experiment has shown encouraging results and further developments are being carefully watched.

Pattern of the Plan

All urban water supply schemes are being designed to be self-sufficient and to be run on commercial lines. The funds required for the execution of the schemes are being advanced as loan to the municipal boards. So far, this has proved quite successful in the case of large schemes but it is not found possible to run small schemes in towns having a population of 25,000 and below on these lines. The policy needs revision, and consideration should be given for granting part of the cost as a subsidy to the small municipal boards.

Drainage schemes

For the execution of drainage schemes according to the pattern of the Plan, funds have to be advanced as loan to the Municipal Boards. The present financial condition of the Boards is far from satisfactory. Moreover, it is difficult to design a scheme which can be self-paying and may be executed and implemented on commercial lines. It is, therefore, necessary to consider the grant of at least 50% of the cost of scheme as subsidy to the local bodies.

Financing of schemes

At the commencement of the Third Plan, it was roughly estimated that the total requirements of the urban schemes will be about Rs. 1,000 crores, but the Third Plan allocation is only about Rs. 89 crores. In this connection, the recommendation made by the National Water Supply and Sanitation Committee of the Ministry of Health deserves special consideration, wherein the establishment of independent statutory bodies have been recommended in each State. These statutory bodies are recommended to be made responsible for sponsoring and promoting water supply and sewage projects for the local bodies in their areas, raise the necessary funds and arrange for the investigation, design, execution, operation and maintenance of projects.

Prevention of river pollution

As pointed out earlier, the State of Rajasthan is growing industrially at a rapid pace. Preventive steps should, therefore, be taken to avoid pollution of its rivers by industrial effluents. The formation of River Pollution Control Boards at the State level has been suggested by the Government of India and deserves early consideration of the State Government.

Research

The importance of research in public health engineering cannot be over-emphasized. The Central Public Health Research Institute, Nagpur, has established a Field Centre at Jaipur and research work is being taken up in collaboration with the Public Health Engineering Department. A number of important problems are being tackled, including evolution of cheap methods for sewage treatment, harnessing of wind power, etc.

Exploratory work

In Rajasthan, the depth of water table varies from 30 ft. to 350 ft., and the quality of water also varies from place to place. Exploratory work has been taken up by the Department and the Exploratory Tube-Well Organization of the Government of India. As a result, a tube-well giving a discharge of 60,000 gallons per hr. has been located about 40 miles from Jaisalmer near Chanan village. Water was found at a depth of about 900 ft. There is great scope for further exploration in the desert and semi-desert areas of the State.

Organization

One of the most difficult problems which the public health engineers have to face all over India is the proper organization of the public health departments. This matter had engaged the attention of the Government of India as early as 1949 and an Environmental Hygiene Committee was appointed to go into the problems of public health engineering. In its report, the Committee had recommended the setting up of independent public health engineering departments with a separate service cadre. Provincialization of the municipal engineering services and their amalgamation with the public health engineering services was further contemplated. Since then, similar recommendations have been made by the Committee on Plan Projects appointed by the Planning Commission and in the conferences of chief engineers. However, the response from various States has not been very satisfactory as indicated by the Health Minister of the Government in the following words : 'Some States are still trying with the idea of managing public health engineering works with a few public health engineers attached to the Public Works Department. This, in my opinion, is short-sighted policy and cannot be conducive to efficiency in the long run.' He further pleaded for coordination of the activities of various agencies in handling water supply and sanitation schemes and suggested the creation of an independent public health engineering organization in each State. Public health engineering activities are expanding, and it is time that independent public health engineering organizations are set up in each State with a service cadre of their own and the municipal engineering services are provincialized and amalgamated with public health engineering services.'

Summaries of Papers Published in the Journal, vol. 42, no. 10, pts. EL 5 & CH 3, June 1962

ELECTRICAL ENGINEERING DIVISION

Predetermination of Electrical Characteristics of Steel Tubes at Power Frequencies

Dr. H. R. Chablani

Associate Member

A detailed study is made of the behaviour of ferromagnetic conductors carrying alternating current, and fairly rigid expressions have been developed to determine the power loss and current distribution using D.C. magnetization characteristics on the assumption that the material is homogeneous. The treatment is more rigorous than previous works, because account is taken of the variation of both the permeability and the hysteresis loop throughout the thickness of the conductor.

It is found that in the usual practical cases of sinusoidal waveform of applied voltage, or, alternatively, of sinusoidal total current, the quantities of fundamental frequency need only be considered. The relationship between m.m.f. and flux density across the thickness of the conductor due to fundamental frequency only is, therefore, obtained by harmonic analysis.

Experimental work was carried out at power frequency on pipes of different diameters and thickness, and covered a wide range of flux densities. The theoretical values of loss calculated from the new formulæ, using actual values of resistivity and variable hysteresis angle of lag, compare fairly with the experimental values.

It is also shown that for high permeability and low resistivity ferromagnetic conductors the A.C. resistance is inversely proportional to the outside radius and is independent of the thickness of the conductor.

Some Research Problems in Electrical Apparatus

Prof. M. V. Deshpande

Member

In this paper, the author suggests a number of problems in the field of 'electrical apparatus' which need further detailed study and investigation. It is hoped that some of the research problems which are suggested would help a number of post-graduate students and research workers in the universities as well as in industries to define their problems of investigation.

Recent Advances in Transformers

A. K. Khosla

Non-member

In recent years, considerable improvements are being made in the design of the transformer. The higher system voltages have been standardized, and a transmission voltage of 500 kV is already in use. With the increasing consumption of electrical energy per person, the demand for power and distribution transformers has increased manifold. Units up to 400 to 500 MVA rating are under construction. On the distribution side, equally impressive progress has been made. The losses, sizes and weights in the equipment have been cut down giving an all-round improvement in performance.

However, the basic problems of the transformer designer remain the same, *viz.*, how to use the existing materials more efficiently and economically, or how to substitute new materials to get improved performance? In the improvements to the transformer, the main aspects involving transformer steel, transformer noise, insulating materials, cooling media, and winding conductor materials are discussed.

Commutation and Radio Interference

K. Padmanabhan

Non-member

and

Prof. A. Srinivasan

Member

The study of commutation in direct current machinery began in the last decade of the nineteenth century. Many workers have attempted the problem and much mathematics must be waded through before a comprehensive picture can be obtained. Learned authors like Arnold were struck with dismay at the ever increasing complexity of this problem, and the many attempts for a solution were not crowned with success.

With the advent of high speed commutator machines in aircraft, the problem has assumed greater significance. Brushes wear at an accelerated pace at high altitudes. High temperaturees consequent upon poor commutation may lead to general failure in such machines. The need for detailed study of the problem was thus badly felt at least in the case of aircraft machinery.

The problem of radio interference voltages generated in commutator machines is not altogether an obscure phenomenon. Initially, the aim of the study of such a problem was to minimize the bad quality of radio reception with D.C. lines. Fractional horse-power motors of commutator type produce great nuisance in this respect, and measures were taken for enforcing tolerance limits to the disturbance in B.S. 613 (1940). Now the problem has obtained a recognition for a deeper study in as much as it is of utmost significance in high speed aircraft. The interference from aircraft machines is not insignificant in the limited space in which such machines work. Thus, special methods should be sought for to reduce the generation of these radio frequencies rather than employ ordinary methods of suppression. Suppression methods employing chokes and condensers impose restrictions with regard to weight and size in the case of aircraft machines, where the question of space and weight is of paramount importance. While the need for reduction of radio interference is widely felt, it is hoped that a thorough understanding of the origin and nature of the phenomenon will enlighten further progress in the line.

Current Generator—Determination of Circuit Constants

V. Prabha Shanker

and

Prof. D. J. Badkas

The paper deals with a method for determining the values of the circuit components required with a current generator to produce the desired impulse current waves.

Modification of a Simple Type of Thermal Relay and Its Comparative Performance

Rattan Singh

Student

In 1950, the author had the opportunity of working on a type of thermal relay used for the protection of direct-on-starting induction motors. In winter (the first time the motors were started), these relays did not exhibit their actual characteristics, but with the approach of summer, they started switching off the motors at random, indicating that a change in the ambient temperature had an effect on them. This indication was also confirmed by investigation on the relays as to their characteristics in the case of sustains loads and instantaneous operation.

To find out whether the designer had accidently missed certain aspects of design which resulted in this defective design of the relays, the author carried out modifications on the relays to study their performance under sustained loads and instantaneous operation. Based on a study of these experimental results and the modified design, the manufacturers produced another type of thermal relay, which, however, did not give satisfactory working. Later, the manufacture of these relays was discontinued. The modifications carried out by the author and the improved working of the relays that resulted from this are explained supported by characteristics curves.

CHEMICAL ENGINEERING DIVISION

Introduction of Two Basic Factors (Q_p and T_c) in the Design of Combustion Furnaces

A. K. Shaha

Member

Fuels are classified (a) according to the state (solid, liquid or gas) in which they exist in nature; (ii) according to the mode of procurement (natural and manufactured); (iii) according to their resistance to heat; and (iv) according to their calorific value. But none of these classifications gives an idea of the qualitative or intensive value of the fuels, *viz.*, their power of developing 'thermal intensity' or 'calorimetric temperature' under normal conditions of operation, *i.e.*, combustion of fuel in mixture with atmospheric air in stoichiometric proportion.

The thermal intensity or calorimetric temperature, T_c, may be determined from the equation

$$T_c = \frac{Q}{C_p' x + H_2O + C_p'' y\, CO_2 + C_p''' z\, N_2} = \frac{Q}{\Sigma C_p V_p} = \frac{Q_p}{\Sigma C_p}$$

where $x + v + z + V_p$ is the total volume of the production of combustion.

It is well known that the values of C_p', C_p'' and C_p''' change with temperature, also differ from one other. Naturally, fuels having the same value of Q_p will have different values ΣC_p, since the percentage composition of the various products, and hence the values of T_c may differ. Fortunately, in reality, these values remain constant for almost all kinds of fuels, both elementary and commercial. Though Bansen introduced the factor Q_p for the estimation of the working temperature in metallurgical furnaces as early as 1922, and Dr. Heiligensteadt made use of this factor in combustion calculations in his works, none of them used this value as the criterion for assigning the characteristics or the classification of fuels.

The author has attempted here, on the basis of his calculations as well as those made by Heiligenstaedt, Haslam and Russel, to prove the validity of his conclusions that the value Q_e may serve as the criterion to describe or classify fuels according to their intensive value or thermal intensity, whereas T_c-values are of use in the design of furnaces.

INSTITUTION NOTICES

Meeting of Corporate Members, New Delhi, 31st March, 1962, for revision of subcriptions

At the Business Session of the 42nd Annual General Meeting held in Calcutta on 3rd February, 1962, a proposal was placed before the meeting by Shri Dildar Husain (*Member*) that the annual subscriptions, entrance fees, transfer fees, and registration fees should be raised in order that the Institution may discharge its greatly increased activities in a proper manner. Discussions then ensured on this proposal.

Following is an extract from the minutes of that meeting:

'The President then put to the house that it seemed to be the sense of the house that while the principle of raising the annual subscriptions and other fees was accepted, the proposals in this respect should be circulated in advance to all Corporate Members for their information and study. He, therefore, said that the necessary arrangements for this would be made, and an Extraordinary General Meeting of Corporate Members called for the revision of annual subscriptions and other fees.

The General Body resolved that the principle of revision of annual subscriptions, entrance fees, transfer fees, and registration fees be accepted and that the actual amounts of subscriptions and other fees be further considered at an Extraordinary General Meeting to be called for this purpose at a place fixed by the President'.

An Extraordinary General Meeting of Corporate Members was thereafter called at Delhi on 31st March, 1962, and a notice to this effect was issued by the Secretary on 5th March, 1962. The Meeting was held in the building of the Delhi Centre of the Institution on that date. Given below is the proceedings of that Meeting:

Minutes of the meeting of Corporate Members held in New Delhi on 31*st March*, 1962

In accordance with the Notice dated 5th March, 1962, issued by the Secretary by order of the Council convening a meeting of Corporate Members on 31st March, 1962, the meeting was held in the building of the Delhi Centre of the Institution, Mathura Road, New Delhi, on that date at 15.30 hours for the following purposes:

'To consider revisions to Regulation 19 which have been proposed by the Council of the Institution, and which received a preliminary consideration by the General Body of Corporate Members at the 42nd Annual General Meeting of the Institution in Calcutta on 3rd February, 1962, as follows:

1. Proposed that Regulation 19 of the Council be amended as shown in the Schedule annexed to the Notice of the Meeting'.

One hundred and twenty-nine Corporate Members were present. 1,101 proxies were also placed at the meeting. The President, Maj.-Gen. Harkirat Singh, was in the Chair.

Proceedings

The President welcomed the Corporate Members to the meeting, in particular those who had come from outside Delhi. He said he would briefly review the events which had led to the present meeting, and also speak about the growth of the Institution in the immediately preceding years.

The President said that a feeling had been growing that annual subscriptions and other fees levied by the Institution were rather on the low side, not compatible with the tremendous growth of the Institution over the last few years. Accordingly, the matter had come up for informal discussion in the Council now and again. Finally, the question was considered by the Council at their 421st Meeting held in Calcutta on 3rd February, 1962. In the ensuing discussion many views were expressed, but the Council agreed that the revision of annual subscriptions, etc. may be put by the President to the General Body of Corporate Members at the Business Session of the 42nd Annual General Meeting which was to be held immediately after the Council meeting.

In accordance with the above, the President continued, the proposal to increase annual subscriptions and other fees was discussed at the Business Session of the 42nd Annual General Meeting on 3rd February, 1962. Some members felt that adequate notice had not been given to Corporate Members for considering the matter, and, therefore, thought that no decision should be taken at that meeting.

At the conclusion of the discussion, the President said he had put it to the house that it seemed to be the sense of the house that while the principle of raising the annual subscriptions and other fees was accepted the proposals in this respect should be circulated in advance to all Corporate Members for their information and study. He told the General Body that the necessary arrangements for this purpose would be made, and an Extraordinary General Meeting of Corporate Members called for the revision. This was generally acclaimed.

The President said that as there was no dissent to his above proposal, it was recorded as a resolution of the General Body in accordance with convention.

The President then traced the development of the Institution over the past few years, more specially in the last three or four years. In particular, he made references to the following : buildings of the Local Centres ; libraries of the Local Centres ; furniture and equipment at the Local Centres ; the expanded programme of publication of the *Journal* ; the Institution examinations ; the growth of technical activities ; the increases in the market prices of materials ; the Public Charitable Trust for the Advancement of Engineering ; and the need for a Benevolent Fund of the Institution.

The President drew the attention of the members to the fact that the Institution was designed at its formation to be a single organization to which engineers of all branches could turn for the exchange of technical information and for the maintenance of high standards in the practice of their profession. Despite fissiparous tendencies for establishing separate organizations for each branch of engineering, the solution of an all-embracing society incorporating all engineers irrespective of their specialist functions in the body of the Institution had been a great and successful experiment.

The President stressed that the Institution could only meet its great responsibilities if the necessary finances were available.

The President finally informed the members that he had received many letters from individual members, direct and through the Secretary, some in favour of the proposed increases, some against. Some Local Centre Committees had passed resolutions disapproving of the proposals, and he had carefully read them all.

The President concluded by hoping that the members would give serious thought to the proposals before them and agree to the increase in subscriptions and other fees as circulated in the Notice or in a modified form. He, therefore, invited members to give their views on the subject.

Shri S. Datta (*M.*), raised a point of order that the meeting was not competent to deal with the subject matter on the Agenda. He said that the revision to Regulation 19 which was proposed to be considered at the meeting was governed by Bye-law 59 of the Institution which said the Council had power to revise or modify the Regulations subject to confirmation at the Annual General Meeting. He was, therefore, of the view that any revision to Regulation 19 was beyond the scope and jurisdiction of the meeting, as such matters could be considered only at the Annual General Meeting.

Shri Datta then said that the resolution of the General Body quoted in the Explanatory Note attached to the Notice of the meeting and said therein to have been passed by the General Body at the Business Session of the 42nd Annual General Meeting held in Calcutta on 3rd February, 1962, was in fact not passed.

The President said that he would reply to the points raised. He said that at the end of the discussion on the proposal to increase the annual subscriptions and other fees which was before the General Body at the Business Session of the 42nd Annual General Meeting at Calcutta, taking into account the opinions voiced by some members that the Corporate Members had not had sufficient time to consider the proposals, he had put it to the house that it seemed to be the sense of the house that while the principle of raising annual subscriptions and other fees was accepted, the proposals in this respect should be circulated in advance to all Corporate Members for their information and study. He had further said that the necessary arrangements for this would be made and an Extraordinary General Meeting called for the revision of annual subscriptions and other fees.

The President then pointed out that in response to this, there was not a single member of the General Body who raised a dissent. Accordingly, the sense of the house was recorded as a resolution. The minutes of the Business Session of the 42nd Annual General Meeting dated 3rd February, 1962, was, therefore, correctly recorded.

Referring then to the competency of the present meeting to deal with the subject matter on the Agenda, the President said that before calling the meeting, the advice of the Institution's legal advisers was taken. It was under their advice that the matter was further proceeded with and the Notice of the present meeting issued. Accordingly, there was no doubt about the competency of the present meeting to deal with the subject matter on the Agenda.

Shri C. L. Handa (*M.*) said that the proposals for the revision of annual subscriptions and other fees were reasonable and should be accepted as they were in the best interests of the Institution. He stressed that with the tremendous growth in the Institution activities in the last few years, more finances were essential to keep up this tempo. The proposed increases, if adopted, would only be ploughed back for the betterment of the Institution, and in turn, for the good of the engineering profession and its members as a whole. He, therefore, urged members to accept them.

Shri K. N. Misra (*M.*) said that he did not agree to the proposed increases. A number of Corporate Members in Uttar Pradesh had also authorized him to express this view.

Shri M. W. Sane (*A.M.*) said he and many members of the Poona Centre were not in favour of the proposed increases. He said that the date of the meeting had prevented many members from attending as it was the close of the Government financial year. He did not agree that the reasons given for the increases were convincing and felt that if the subscriptions were raised, the membership would be adversely affected.

Shri K. M. Chakravorti (A.M.), said that he was also not in favour of the proposed increases and was authorized to say so by many Corporate Members from the Bengal Centre.

Shri R. K. Varma (*A.M.*) said he did not consider that the increases in subscription were necessary, and thought that as the membership increased, the subscriptions should be reduced.

Wg.-Cdr. V. G. Nayanar (*M.*) said that he could not support the proposals for increase and quoted some figures on expenditure items of the Institution in support.

Sqn.-Ldr. N. K. Nair (*A.M.*) said that he was in agreement with Wg.-Cdr. Nayanar. He referred to a cyclostyled paper which had been circulated to members before the meeting, in which a comparison had been given between the income and expenditure of the Institution and some other societies.

Shri D. V. S. Iyer (*A.M.*) said that he was in agreement with Shri Sane. He said that the proposed increases were not justified, and if passed would seriously affect the membership drive.

Col. K. C. Soni (*A.M.*) said that he fully supported the proposals for increase. He said the standard of work done by the Institution would not attain the standards of other foreign Institutions in matters such as publications, unless the necessary finances were available. He said it would serve no purpose criticising the quality or quantity of the publications unless members were prepared to support the Institution in an adequate manner.

Shri Baleshwar Nath (*M.*) agreed that more finances were necessary for conducting the activities of the Institution. He, however, thought that a concession may be given to members already on the Roll. He suggested that their subscriptions may remain at the present figures, and the new subscriptions made applicable to new entrants.

Shri B. P. Kapadia (*M.*) said that he was in full agreement with the increased proposals. He said he had been associated with the Institution for a long number of years and knew the various activities intimately. He pointed out that the President and the Secretary had a considerable job in balancing the Budget each year, but even so, extremely good results had been achieved. He urged that the proposals be approved in the general interest.

Brig. P. R. Kumar (*M.*) strongly supported the proposals for increase. He said there were two groups of opinion in the Poona Centre. Certainly one group was in favour of the proposed increases.

Dr. Shiv Narayan (*M.*) said he was one of very senior members of the Institution and accordingly keenly aware of its work and its needs. He said he would like to commend the proposals for increase with or without modifications.

Shri P. H. Vaidyanathan (*M.*) said that the increases might be scaled down and then accepted. He had also been authorised to say so by a large number of Corporate Members from Kerala.

Lt.-Gen. Sir Harold Williams (*M.*) said that much as the proposals for increase may be distasteful to members, they should be realistic and accept 25% increase from the present rates.

Shri Dildar Husain (*M.*) said he would first like to refer to Shri Datta's observation that the resolution authorizing the calling of the present meeting had not been passed at the Business Session of the 42nd Annual General Meeting at Calcutta. He said that he himself was the author of the original resolution proposing the increases of annual subscriptions and other fees. As such he was closely watching the progress of the discussion at that meeting, and had no doubt whatsoever that the minutes had been correctly recorded, and the President had earlier today given a full picture of what had happened at that meeting. He said he knew of the Institution finances intimately, and refuted some figures given by two members in the foregoing discussion on expenditure items as incorrect. He urged the members to give serious thought and agree to the proposed increases over the present rates.

He then suggested that, to simplify matters, he would like to put it to the Chair that the various opinions expressed may be considered by a small Committee to be appointed by the President during which time the General body might adjourn.

The President accepted Shri Dildar Husain's proposal and appointed the following Committee. He requested them to consider the various views expressed in the house and place definite recommendations before the General body after the adjournment:

Sarvashri Dildar Husain (*M.*) (Past-President) (Chairman), K. M. Chakravorti (*A.M.*), S. Datta (*M.*), B. P. Kapadia (*M.*), Brig. P. R. Kumar (*M.*), Sarvashri K. N. Misra (*M.*), M. W. Sane (*A.M.*), Dr. Shiv Narayan (*M.*), Brig. G. S. Sihota (*M.*), and Shri P. H. Vaidyanathan (*M.*)

The President then adjourned the meeting at 5.30 p.m. and requested that members may reassemble at 6 p.m.

The meeting was then adjourned for Tea which was provided by the Delhi Centre.

The meeting resumed at 6 p.m.

Shri B. N. Kashyap (*A.M.*) said that he was not in favour of the proposed increases and that the present rates were adequate.

On the invitation of the President, Shri Dildar Husain (*M.*), Chairman of the Committee appointed by the President, placed a signed report of the Committee with its recommendations before the President.

The President informed the house that the report of the Committee was before him signed by all the members, with one of them in disagreement. He said the house might like to consider the main point which had struck him in the recommendations. This was that for the grades of Associate Member and Affiliate Member no increases in subscription were recommended, while for the other grades increases were favoured.

After discussion, the house felt that whatever the recommendations of the Committee, they should now be put to the house.

Accordingly, the President read out the recommended figures of revised subscriptions by the Committee as follows:

Member	..	Rs. 80
Associate Member	..	Rs. 50
Companion	..	Rs. 100
Affiliate Member	..	Rs. 50
Graduate	..	Rs. 40
Student	..	Rs. 35
Subscriber	..	Rs. 250

The President then said that the Committee had also recommended a 50 per cent increase against all grades for entrance fees, transfer fees, and registration fees.

Shri Dildar Husain (*M.*) formally proposed that the recommendations be adopted. Shri P. H. Vaidyanathan (*M.*) seconded the proposal. The President then called for a vote by show of hands. Members holding proxies called out the numbers with them.

The proposal was carried by an overwhelming majority, taking into account the following numbers of proxies: proxies in favour of those who voted in favour: Cdr. K. K. Batta (*A.M.*) 100, Shri K. M. Chakravorti (*A.M.*) 119, Shri S. Datta (*M.*) 391, Shri K. N. Misra (*M.*) 124, and Shri P. H. Vaidyanathan (*M.*) 46; proxies in favour of those who voted against: Shri M. W. Sane (*A.M.*) 58, members who could not be identified 33. (The Secretary confirmed that these proxies, excluding the members who could not be identified, had been registered with him. The numbers were correct).

The President then declared the proposal as carried.

With a vote of thanks to the Chair, the meeting terminated at 7.15 p.m.

Revised Draft Code of Ethics for Corporate Members

The revised Draft Code of Ethics for Corporate Members prepared by the Headquarters, on the desire of the Council, is given here for information of members. Any comments on this draft should be sent to the Secretary so as to reach him on or before July 31, 1962.

Foreword

A Corporate Member should recognize the principles of honesty, justice and courtesy to guide him in the practice of his profession and in his personal conduct. He should not merely observe them passively, but should apply them dynamically in the discharge of his duties to the public and the profession.

He should scrupulously guard his professional reputation and avoid association with any enterprise of questionable character. He should uphold the dignity and honour of the Institution.

The Code

1. A Corporate Member will cooperate with others in his profession by the free interchange of information and experience, and will contribute to the work of engineering institutions to the maximum effectiveness he is capable of.

2. A Corporate Member will endeavour to protect the engineering profession from misrepresentation and misunderstanding.

3. A Corporate Member will refrain from expressing publicly an opinion on an engineering subject unless he is informed as to the facts relating to that subject.

4. A Corporate Member will express an opinion only when it is founded on adequate knowledge and honest conviction if he is serving as a witness before a court or commission.

5. A Corporate Member will not divulge any confidential findings or actions of an engineering commission or committee of which he is a member, without obtaining official consent.

6. A Corporate Member will take care that credit for engineering work is given to those to whom credit is properly due.

7. A Corporate Member will not offer his professional services by advertisement or through any commercial advertising media, or solicit professional work either directly, or through an agent, or in any other matter derogatory to the dignity of the profession.

8. A Corporate Member will not submit a proposal for an engineering engagement unless he is invited to do so.

9. A Corporate Member will not directly or indirectly injure the professional reputation or practice of another Corporate Member.

10. A Corporate Member will exercise due restraint in criticizing the work of another Corporate Member and remember that the proper forum for technical criticizm is an engineering society or the engineering press.

11. A Corporate Member will not try to supplant another Corporate Member in a particular employment.

12. A Corporate Member will not compete unfairly with another Corporate Member by charging fees below those customary for others in his profession practising in the same field and in the same area.

13. A Corporate Member will not associate in work with an engineer who does not conform to ethical practices.

14. A Corporate Member will act in professinal matters for his client or employer as a faithful agent or trustee.

15. A Corporate Member will not misrepresent his qualifications to a client or employer or to the profession.

16. A Corporate Member will not disclose information concerning the business or technical affairs of his client or employer without his consent.

17. A Corporate Member will present clearly the consequences to be expected if his professional judgment is overruled by a non-professional authority where he is responsible for the professional adequacy of the work.

18. A Corporate Member will act with fairness and justice between his client or employer and the contractor when dealing with contracts.

19. A Corporate Member will not be financially interested in the bids as or of a contractor on competitive work for which he is employed as an engineer unless he has the written consent of his client or employer.

20. A Corporate Member will not receive any commission, discount or other indirect profit in connection with any work with which he is entrusted.

21. A Corporate Member will make his status clear to his client or employer before undertaking an engagement if he may be called upon to decide on the use of inventions or equipment or any other thing in which he may have a financial interest.

22. A Corporate Member will immediately inform his client or employer any interest in a business which may compete with or affect the business of his client or employer.

23. A Corporate Member will not allow an interest in any business to affect the engineering work for which he is employed or may be called upon to perform.

24. A Corporate Member will engage or advise engaging engineering experts and specialists when in his judgment such services are to the interests of his client or employer.

25. A Corporate Member will not review the work of another Corporate Member for the same client, except with the knowledge of the second Corporate Member, unless such engineering engagement or the work which is subject to review is terminated.

26. A Corporate Member will not accept financial or other compensation from more than one interested party for the same service, or for services pertaining to the same work, without the consent of all interested parties.

27. A Corporate Member will subscribe to the principle of appropriate and adequate compensation for those engaged in engineering work, including those in subordinate positions.

28. A Corporate Member will endeavour to provide opportunity for the professional development and advancement of engineers in his employ.

29. A Corporate Member will, if he considers that another Corporate Member is guilty of unethical, illegal or unfair practice, present the information to the Council of the Institution for action.

30. A Corporate Member who is engaged in engineering work in a country abroad will order his conduct according to the professional standards and customs of that country, adhering as closely as is practicable to the principles of this Code.

Papers on latest developments in engineering

As Convener of the Engineering Research Committee, Prof. N. S. Govinda Rao (*M.*), Chairman, Civil Engineering Division, desires to make the following announcement.

It is proposed to publish a series of papers on the latest developments in a number of engineering fields of current interest. Members of the Institution are requested to correspond with Prof. N. S. Govinda Rao, Convener, Engineering Research Committee, and Professor of Civil and Hydraulic Engineering, Indian Institute of Science, Bangalore 12, indicating the subjects they would like to review and/or suggest for review. The subjects selected should be limited in scope so that the review of the same could be made in not more than 5,000 words, which is the normal length of a paper.

A few topics in civil engineering are suggested below as indicative of the type that will be considered for review :

1. Problems of slum clearance
2. New engineering materials
3. New techniques of construction
4. Plastic behaviour in structures
5. Design of structures against earthquakes
6. Cavitation
7. Turbulence
8. Sedementation
9. Trends in the design of centrifugal pumps
10. Trends in the design of turbines
11. Land reclamation
12. Water conservation and re-use of drainage water for irrigation
13. Design of high gravity dams
14. Design of earth dams
15. Design of arch dams
16. Sewage treatment
17. Grouting

18. Soil dynamics
19. Use of electronic computers in engineering problems
20. Shells theory

The Proceedings of the Symposium on Economy and Efficiency of Engineering Enterprises in India, New Delhi, November 12-13, 1961

The *Proceedings of the Symposium on 'Economy and Efficiency of Engineering Enterprises in India'*, held in November 1961 at New Delhi, will be available for sale from July 1, 1962, at Rs. 15.00 per copy at the Head Office cash counter. The price per copy for supply outside Calcutta is Rs. 16.12 nP, inclusive of registered postage. Members desirous of purchasing the *Proceedings* may please send the remittance to the Technical Officer (Scientific), giving the correct address to which the copy will have to be mailed.

Rules and Syllabuses of Studentship and Associate Membership Examinations

Copies of 'Rules and Syllabuses of Studentship & Associate Membership Examinations' for the new scheme of Institution examinations effective from November 1962 are now available for sale at Rs. 2.50 per copy at the Head Office cash counter. Requests for supply of the above from outside Calcutta may be addressed to the Controller of Examinations, Institution of Engineers (India), 8 Gokhale Road, Calcutta 20, accompanied by Rs. 3.32 (inclusive of registered postage). The copies of the same can also be had at Local Centre offices.

Addresses wanted

The mails of the following members have been returned undelivered. Any member in a position to assist the Headquarters with their present addresses is requested to do so.

Member

M 1127 S. Guruswami,
14 Jagadeeswar Street, T. Nagar, Madras.

M 971 V. A. Majumdar,
Bungalow 84, P.O. Thalakwadi, District Belgaum.

M 860 R. Madhavachari,
Chairman, M.S.M. & S.I. Railways Joint Service Commission, 53 Gangadheswarar Koil Street, Vepery, Madras.

M 560 L. B. Green,
'Orchard', Kodaikanal.

M 395 Nawab Ahsan Yar Jung,
Retd. Chief Engineer & Secretary to Government P.W.D., 131/171 Chapel Road, Fateh Maidan, Hyderabad.

Associate Member

AM 546/L V. Bangaraswami,
Deputy Chief Engineer (Retd.), Southern Railway, 1/1 Abhiramapuram, 4th Street, Teynampet, Madras 18.

AM 1714 S. S. Gandhbir,
Housing Board Colony, T. No. 85, Sion, Bombay 22.

AM 5672 B. P. Sharma,
P.O. Kalyani, District Nadia.
AM 4950 C. D. Bhatt,
Bungalow No. T/31, Range Hills, Kirkee, Poona 3.
AM 7758 B. Ghosh,
c/o Resident Engineer, Indian Gemeinschaft, Krupp-Demag, G.M.b.H., Rourkela.
AM 4956 M. Gopalakrishna Iyer,
Assistant Engineer, C.P.W.D., Room No. 122, 'G' Block, New Delhi.
AM 3644 G. S. Prasad,
Assistant Engineer, Moh-Dahiawan, Chapra.
AM 3473 A. S. Hedge,
Assistant Engineer, P.W.D., Vadakkancheri, Palghat.
AM 4194 J. C. Bagchi,
Resident Engineer, Orissa Cement Ltd., Rajgangpur, P.O. Ranibandha, District Sundargarh.
AM 7510 K. P. Palit,
Assistant Executive Engineer (C), Heavy Electricals Ltd., Quarter No. 285, Type C3, Piplani, Bhopal.
AM 5825 C. X. C. F. Miranda,
Gulabmala Camp., Baroda.
AM 5094 C. A. Mogose,
P6 Diamond Harbour Road, Alipore, Calcutta 27.
AM 3434 R. N. Mohgaonkar,
Chief Inspector of Factories, Haji Ali Park, 14A/4, Mahalaxmi, Bombay 11.
AM 7158 Maj. M. S. Nagarajan,
Electronics Wing, E.M.E. School, P.O. Trimulgherry, Secunderabad.
AM 7347 Flt.-Lt. K. N. Natarajan,
Technical Adjutant, Indian Air Force Station, Kanpur.
AM 7926 Maj. R. K. Bammi,
Defence Services Staff College, Wellington.
AM 9206 C. S. R. Rao,
Assistant Engineer, P.W.D., Nagarjunasagar Project, Special Investigation Sub-Division No. 1, Guntur.
AM 6241 P. K. Banerji,
Divisional Engineer (3), Eastern Railway, 8 Gardiner Road, Lillooah, Howrah.
AM 1510 V. S. Ratnam,
13 Gandhi Road, Salem.

Graduate

G 559 S. Datta,
Lecturer in Mechanical Engineering, Engineering College, Banaras Hindu University, Banaras 5.
G 736 C. R. Mehta,
c/o. Hindustan Electric Co. Ltd., Faridabad.
G 808 K. N. Singh,
111-R, Model Town, Rohtak.
G 896 A. D. Patwardhan,
Plot No. 9, Shri Krishnanagar, Borivli East, Bombay 66.
G 1142 U. S. Ramasubramanian,
Assistant Lecturer in Mechanical Engineering, Government College of Technology, Coimbatore 3.

Draft Indian Standard

The following draft Indian Standard has been issued recently.

Draft Indian Standard Code for Classification of Processed Ferrous Scrap—Doc: SMDC 1(344).

Members may send their comments on the above draft Standard before August 16, 1962, to Dr. D. R. Malhotra (*M.*), Golf Course Road, Ajmer, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta; 14/69 Civil Lines, Kanpur or 2/21 First Line Beach, Madras 1.

FORTHCOMING CONFERENCES

Second Symposium on 'Earthquake Engineering', University of Roorkee, November 10-12, 1962

The Second Symposium on 'Earthquake Engineering' will be held at the University of Roorkee under the auspices of the School of Research and Training in Earthquake Engineering, University of Roorkee from November 10-12, 1962. The scope of the Symposium will cover the following aspects:

1. (i) Geological features affecting earthquake occurrence; and (ii) Geological studies for engineering projects in seismic zones.
2. Seismological studies and programme in India.
3. (i) Instruments connected with seismology and earthquake engineering studies; and (ii) Analysis of structures for dynamic forces.
4. Vibration studies of soils.
5. (i) Ultimate strength of structures; and (ii) Constructional features in seismic zones.
6. (i) Design of structures for earthquake forces; and (ii) Design of dams in seismic zones.

Papers are invited for presentation and discussion at the Symposium. Members desirous of contributing papers to the Symposium should send a summary of the paper with a brief sketch of their professional career to Prof. Jai Krishna, School of Research and Training in Earthquake Engineering, University of Roorkee, so as to reach him on or before September 15, 1962. Last date for receipt of full text of the papers is September 30, 1962.

Further details regarding the Symposium can be had from Prof. Jai Krishna, School of Research and Training in Earthquake Engineering, University of Roorkee, Roorkee.

Symposium on 'Plastic Insulated Mains Cable Systems', London, November 1-2, 1962

A Symposium on 'Plastic Insulated Mains Cable Systems' will be held in London on November 1-2, 1962, under the auspices of the Institution of

Electrical Engineers, London. The scope of the Symposium will cover (i) design and manufacture of plastic insulated mains cables, (ii) operational experience and impact of plastic insulated mains cables on system planning and economics, (iii) high voltage polythene cables and their applications, (iv) design, manufacture and applications of the accessories associated with plastic insulated cables, and (v) industrial and mining applications of plastic insulated cables.

Further details regarding the Symposium can be had from the Secretary, The Institution of Electrical Engineers, Savoy Place, London W.C. 2.

Symposium on 'Transient, Fluctuating and Distorting Loads and Their Effect on Power Systems and Communications', London, February 1963

A Symposium on 'Transient, Fluctuating and Distorting Loads and their Effects on Power Systems' will be held in London in February 1963, under the auspices of the Institution of Electrical Engineers, London. The scope of the Symposium will cover (i) sources of disturbance, (ii) effects of disturbance, (iii) acceptable limits of disturbance, (iv) corrective measures, and (v) economic considerations.

Further details regarding the Symposium can be had from the Secretary, Institution of Electrical Engineers, Savoy Place, London W. C. 2.

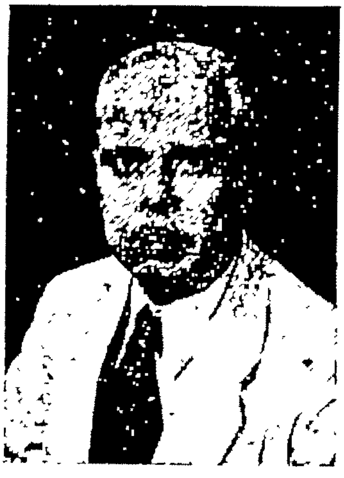
OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here.

Shri U. N. Jha

Shri Uma Nath Jha, B.Sc.(Eng.), M.I.E., died on March 30, 1962, at the age of 50.

Shri Jha graduated in civil engineering from Bihar College of Engineering, Patna, in 1934. After practical training in the Public Works Department, Bhagalpur, for one year he joined the Champaran District Board as Supervisor. From 1937 to 1942, he worked as Estimator in the Bihar Public Works Department. He was appointed Assistant Engineer, Irrigation Department, in 1943. He was promoted to Executive Engineer in 1945, and Superintending Engineer in 1956. During his professional career, Shri Jha was responsible for the design and construction of a number of dams, barrages and tube-wells in Bihar.



Shri Jha joined the Institution as Student in 1935, and was transferred to Associate Member in 1949 and to Member in January 1962.

Shri A. C. De

Shri Anil Chandra De, B.E., M.I.E., died on April 19, 1962, at the age of 59.

Shri De obtained the B.E. (Civil) degree of the Calcutta University in 1927. After an apprenticeship of two years with the then B.B.&C.I. Railway, Shri De was appointed Assistant Engineer in 1930. He was promoted to Executive Engineer in 1945. He was appointed Regional Engineer, Western Railway, in 1955 and Deputy Chief Engineer in 1956. During this period, Shri De was responsible for the construction of a number of broad gauge and metre gauge railway lines, and remodelling of workshops. He joined the Durgapur Steel Project as Superintending Engineer in 1958 and was later appointed Deputy Chief Engineer.

Shri De joined the Institution as Associate Member in 1931, and was transferred to Member in 1958.

Shri H. G. Trivedi

Shri Har Govind Trivedi, A.M.I.C.E., M.I.E., died recently at Lucknow at the age of 67.

Shri Trivedi obtained the Civil Engineering Diploma of Thomason College of Civil Engineering, Roorkee, in 1917. He joined the Liquid Fuel Project, North-Western Railway, Karachi, as an apprentice in 1917, and was appointed Temporary Engineer in 1918. In 1919, he joined the Public Works Department, Uttar Pradesh, as Assistant Engineer, and was promoted to Executive Engineer in 1935. During this period, he was responsible for the development of a number of piped water supply and drainage schemes in the State. He became Superintending Engineer in 1942, and Chief Engineer in 1949. He was the first Indian to hold this post. During this period, he was responsible for remodelling of *Har-ki-Pairi* at Hardwar and the provision of water supply arrangements at military centres in the State. After retirement in 1951, he held the post of Chief Engineer, Kanpur Development Board, till 1957.

Shri Trivedi joined the Institution as Associate Member in 1922, and was transferred to Member in 1940. He was a Vice-President of the Institution and Chairman of the Uttar Pradesh Centre in 1942 and again in 1951.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

A CONSTRUCTION ENGINEER of 24 years standing and with good contacts is willing to represent technical and business interests in Madras of engineering and industrial firms. Please write to Viswakarma Engineering & Industrial Services, Post Box 649, Madras 4.

THE BULLETIN

OF

The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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CHANGE OF ADDRESS

Prompt and quick service to membership depends much on the maintenance of an up-to-date mailing list. Unfortunately, it is frequently observed that the change of address is mentioned by members as an 'incidental' in their letters directed to other specific enquiries, thereby involving the risk that this item may often pass into the files un-noticed after the enquiries are attended to—this risk imposed on the Institution re-telling itself in the non-receipt of mail, publications, etc., addressed to members.

It is in this important context that we now request you to extend your cooperation in keeping this list current, by furnishing precise and correct mailing instructions in the Address Plate that is attached to this *Bulletin*. You will please note that if your address as registered in the Institution needs no change, you need take no action ; but if it needs a change, please return the 'Address Plate' giving your membership number and the exact address to be recorded by us.

THE TECHNOLOGIST AND POWERS OF EXPRESSION

B. Seshadri

Member

There is close connection between thought and speech and the written word. The technologist, the up-and-coming man of India's future, should therefore equip himself with the power to express, in speech and in writing, his thoughts—a power to which he seems increasingly a stranger. The average technologist in India today, when he talks or writes about his technology, talks vaguely and expatiatingly. He might himself know precisely what he is talking or writing about, but the point of his talk or writing is to make others understand it. If what he wants to convey is to be seen clearly for what it is, he needs to put it clearly and not discursively.

If we leave talking aside as the more difficult to cultivate, the technologist has still to make the attempt at precision with his writing. Unfortunately, the lack of attention paid to technical writing in the educational training of the technologist has left the young technologist unconscious of the importance of his written words. He is not made aware that words are necessary to explain his work. He takes pride in his deeds but is not embarrassed at his lack of elementary literary skill. All this will apply whatever the language of writing—English, Hindi, or any other. Any talk of languages brings uppermost to one's mind the present languages confusion in the country, the technologist's greatest enemy. The ill-effects of this on his technology are going to be profound.

No technological work can begin, progress and achieve its purpose without the use of words. These words are seldom prepared for the benefit of the writer. They are intended to be read by others. If they are not, they fail in their object. Therefore, the reader's point of view must come first, and the writing planned and executed for the group of readers it is wished to reach.

Technical writing—or, for that matter, any writing—is admittedly not easy. But, with patience, the lack of skill in the selection of words ought to disappear. While the average technologist is unlikely to blossom out into a writer of rare ability, he might at least attain that working knowledge to enable him to translate his experience into interesting words.

The fact that one is a technologist, a man who is already clever and does things, does not absolve him from stating his observations clearly. But this is often given as an excuse—a dangerous and exaggerated attitude. The effect of this on his technology may be far-reaching. He might get more and more woolly-worded with the passage of time, with a contempt for precision, first in his writings, and then in other things.

After all, the technologist who wants to get ahead finds a considerable amount of his time is being taken up by writing for others to read. If the writing is not effective and direct, and if it does not mean what the writer intends, readers who may be specialists in their fields will have little confidence in the authority of the article or its significance. No one will be persuaded or convinced.

Another excuse that is offered is that the technologist is too busy to find time to write well. This cannot pass inspection. Technologists are no more busy than men in other professions. So much of the activity of the technologist consists of the output of words, that it is something of a paradox that a desire to cultivate a little clarity and accuracy in this output is not emphasized in technological education, nor does the graduate or mature technologist even pause to think about it.

Regularity, uniformity, precision and balance, said Matthew Arnold, should characterise any piece of good writing. It is necessary to plan a technical writing. Ideas have to be arranged. A definite attitude towards the reader is necessary—an opinion of how much he is likely to know, and how much he is capable of taking in. A certain workmanlike ability can come fairly quickly if three basic rules are observed. These are simplicity of expression, meaning what is being said, and a logical development of the subject.

After the writing is over, the writer should try to edit his written words. He should try to be objective enough to see his writing as the reader does. He should check for grammatical correctness and eliminate verbosity.

If the technologist approaches his writing as a challenge to his judgment, knowledge and accuracy as well as literary skill, and if he genuinely cultivates the belief that all writing is written to be read, the standard of the technological writings with which we are inflicted today will improve.

Contemporary World Engineering Projects Series—22

Members are invited to contribute to this Series special articles featuring major engineering projects which they may have visited or with which they may have been associated in any other manner. Articles should be preferably accompanied by photographs and illustrative sketches.

DUNGENESS NUCLEAR POWER STATION

S. K. Biswas
Non-member

General

The Dungeness nuclear power station is the sixth nuclear station under construction by the U.K. Central Electricity Generating Board as part of their 6,000 MW nuclear power programme. Besides this, six large commercial nuclear power stations are at present under construction in Britain. Including the Dungeness, they represent a total electrical output of over 3,000 MW. The commissioning of the first two stations and supplying power to the national grid is due within a short period, and these are expected to be in operation before the end of 1965. Construction of nuclear power stations of larger output is expected to continue at the rate of one station per year.

This programme of nuclear power development was undertaken to fill as economically as possible a major gap between the supply of and the demand for indigenous coal for electricity production. This gap was expected to appear in 1965.

Commercial power production from nuclear fuel is a long and costly process. Success in this field can be achieved only by progressive design and constructional experience of power stations on a scale similar to those ultimately required.

The Dungeness nuclear power station is located on the shingle headland of Dungeness on the Channel coast, some 74 miles south-east of London. The two reactors in the station are of the gas cooled, graphite moderated type and follow the general design of earlier reactors and also incorporate the latest developments in reactor technology. The station will ultimately contain four 142 MW turbo-alternators. The contract for the construction of the station was awarded to the Nuclear Power Group in July 1960; the site work was started in August 1960, and the first half of the station is expected to start production of power in 1964.

Dungeness is the first nuclear station of the gas cooled type to be offered at a contract price of less than £100 per kW and has thereby achieved a reduction in the cost of nuclear power generation. There is no basic change in its design and layout as compared with the Bradwell, the Latina, the Hinkley Point and the Trawsfynydd power plants. Number of gas circuits has been reduced from six to four per reactor in this design, and the gas pressure has been increased from 255 to 283 lb. per sq. in. There will also be a modest increase in electrical output per tonne of uranium fuel.

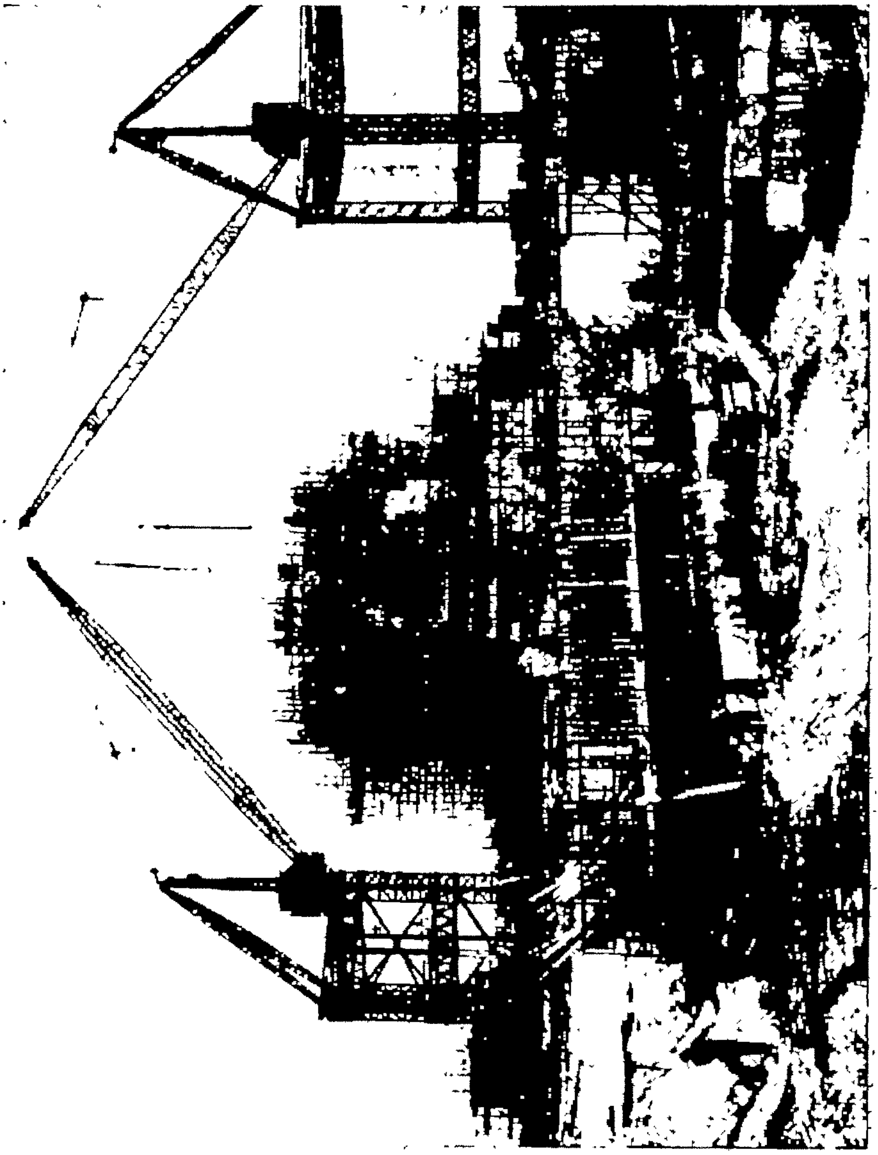

Fig. 1

Reactors of the Dungeness power station under construction

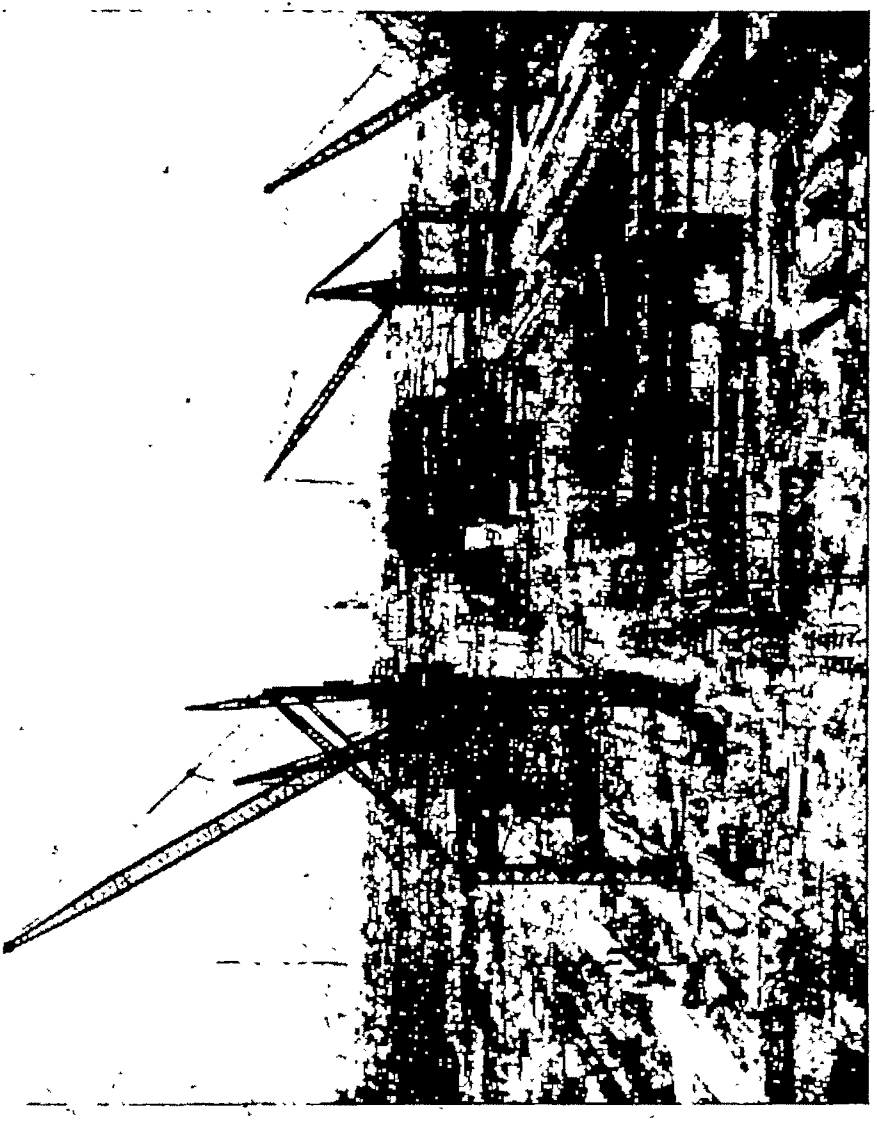

Fig. 2
Biological shield for no. 1 reactor under construction

An interesting features of the Dungeness power station is that the reactor gas inlet temperature is increased to 250°C. in association with a reheat steam cycle, and direct steam turbine drive is used to run the blowers. This has led to higher thermal efficiency. It has, however, to be emphasized here that though higher thermal efficiency is obtained, the operating temperature of the uranium fuel and its canning material remain the same.

Gas pressure and inlet temperature

With the use of increased gas inlet temperatures, there is a tendency to adopt the highest gas pressure possible. But it is found that there is no significant advantage in increasing the gas pressure beyond 300 lb. per sq. in. However, the pressure to be used is determined by the maximum available thickness of good quality steel plate which can be successfully welded at site for the construction of the reactor pressure vessel. The Dungeness pressure vessel is made of 4 in. thick plate, except the support course which is of $4\frac{1}{2}$ in. thick plate. Restricting of the creep temperature below the dangerous level is effectively achieved by insulating the internal parts of the vessel by providing layers of dimpled stainless steel foils where the outlet gas comes in contact with the vessel. The diameter of the vessel is 62 ft. 6 in. which contains gas at a working pressure of 283 lb. per sq. in. To improve the steam cycle and reduce the blowing power of the blower, the designers have made use of this extra gas pressure at Dungeness. The gas inlet and outlet temperatures will be 250°C. and 410°C. respectively.

A major problem in turbine design is excessive wetness of steam. Improvement has taken place in this direction with the introduction of the 'reheat cycle'. This cycle has been economically used by the adoption of back pressure turbine drives for the blowers instead of electrical motors. Steam is generated at two different pressures in the heat exchangers. The entire high pressure steam passes to the back pressure turbines and then returns to the heat exchangers for being reheated to the original temperature of 391°C. before joining the low pressure steam flowing to the main turbines. Thus, steam at one pressure only is used by the main turbines, simplifying the turbine design.

It is important to note that the optimum reactor gas inlet temperature is higher in the case of a reheat cycle than in a conventional dual pressure cycle. The optimum gas inlet temperature for the Dungeness power station, from the point of unit generation cost, lies between 240°C. and 250°C. The optimum value for minimum plant cost may be a little lower.[3]

Wigner energy

By increasing the gas inlet temperature to 250°C., the problem of Wigner energy is somewhat made easy. A gas temperature of 250°C. will reduce the peak rate of energy storage to one-half of what would normally occur with a gas temperature of 200°C. This advancement is utilized in the Dungeness core design, and the core is, therefore, expected to last twice as long as a core operating at a similar neutron flux but lower gas temperature. High operating temperatures are desirable to check the growth of graphite. Theoretical results show that the rate of growth of graphite is reduced by a factor of 10 when the gas inlet temperature is 250°C. This

Fig. 3

Work in progress on the top dome of no. 1 reactor pressure vessel

results in reduction of clearance between the graphite bricks. This is another departure from the earlier designs.

Higher gas inlet temperature is also expected to improve the ductility of the bottom half of the fuel element can and reduce the growth of uranium. The irradiation damage on the lower half of the reactor pressure vessel will also be reduced due to continuous annealing at the higher temperature, which was absent in the earlier designs.

Gas circuits

The number of gas circuits has been reduced to four per reactor in this design as compared with six in the earlier design, and this has lead to greater economy and reduction in capital costs. This was possible due to the increased gas pressure. The design of inlet ducts is slightly different from the conventional; the ducts now go easily into the vessel below the core support grid. Expansion bellows on each ducting are in

Fig. 4

Steelwork for the turbine house at Dungeness

one plane, so that the amount of tension produced by the bellows hinges is significantly small.

Heat exchangers

The Dungeness heat exchangers are of the natural circulation type on the steam side. This is a departure from the conventional design of forced circulation type. Keeping in view reliability of operation and economy, natural circulation was adopted. This gives inherent safety in operation in the event of electrical failure, as no electrical circulating pump is used.

In order to maintain natural circulation, the steam drums are placed high up in the boiler room. The drums and valves for each pair of boilers are grouped together in a shielded room high up in the boiler room. The heat exchangers are 75 ft. high and 23 ft. 6 in. in diameter. The shell thickness varies from $3\frac{7}{8}$ in. at the top to $2\frac{11}{16}$ in. at the bottom. In the present design, rocker supports are used in place of the skirt, which were used in the earlier design also. This type of arrangement is essential because the high temperature gas leaving the heat exchanger shells introduces a serious expansion problem in the boiler support. It also intensifies the effect due to the large height and diameter of the shell. Besides economizer, evaporator and superheater banks, there are some reheat banks of tubes to handle the exhaust steam coming from the blower turbine. The tube banks are arranged so as to give crossflow of water and gas. The tubes are brought out on one side into the shell, and the tube banks so arranged as to reduce the number of penetrations of the shell to the minimum, thus maintaining the strength of the vessel.

Reactor core

The lattice pitch of the Dungeness reactor core is 7¾ in. and the fuel channel diameter 3⅞ in. The engineering design of the core is like the Latina nuclear power station in Italy. In this design, a square lattice of fuel channels is made up with alternate octagonal and square bricks keyed to each other in such a way that the overall core dimensions are independent of foreseeable changes in the dimensions of the graphite bricks. The design also ensures that the straightness of the fuel channels is independent of dimensional changes due to graphite growth or temperature.[2]

Fuel elements

The Dungeness reactor fuel elements are in many respects similar to the fuel elements used in the Bradwell, Latina and Hinkley Point reactors. A uranium bar of 1.1 in. diameter is used. A small diameter bar was chosen to reduce the tonnage of fuel in the reactor, but, it was later found that it does not make any contribution to the unit generation cost. However, in order to get high thermodynamic cycle efficiency, the can surface temperature was increased to a high limit. The maximum can surface temperature and the maximum centre uranium temperature are now close to the limiting values permissible for magnox and uranium, *i.e.*, 480°C. and 615°C. respectively.

Constructional progress

In December 1961, the bottom dome of the no. 1 reactor pressure vessel was lowered in position in the reactor vault, a Goliath crane being used to lift the dome.

The civil engineering work is progressing rapidly. The biological shield for no. 1 reactor has reached almost the final level. Work on no. 2 reactor is progressing rapidly but, according to schedule, no. 1 reactor is in a more advanced stage of construction.[3]

The turbine house structural steel work is also progressing. The surrounding support walls are being erected along with the steelwork. Work on the four boilers and the thermal dome is in an advanced stage of construction. Stub pipes are being welded on the top dome of the reactor pressure vessel, as shown in Fig. 3.

Acknowledgment

Thanks are due to the Nuclear Power Group, Cheshire, England, for their interested cooperation in supplying photographs of their recent projects on nuclear power station construction and in furnishing data and information in the preparation of this paper.

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ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Mysore Centre

Chairman's address by Shri B. R. Manickam, B.E., M.Sc., M.ASCE M.I.E., at the 27th Annual General Meeting of the Centre on January 15, 1962

The Chairman welcomed the Chief Guest, Shri H. K. Veeranna Gowdh, Minister for Public Works and Electricity, Mysore, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

During his address, Shri Manickam spoke on some aspects of town planning, with particular reference to the planning of the metropolitan region of Bangalore city, in the following words, 'Bangalore is a city of recent. The modern history of Bangalore, which literally means 'the town of boiled beans,' may be said to commence from 1537 A.D. when Kempe Gowda built a main fort. Whether it was accidental or due to the vision and foresight of Kempe Gowda, that this particular site was selected for his capital, we cannot say, but the city has since grown steadily both in population and importance, and today occupies a prominent position on the industrial and political map of India.

It may be only of historical importance, but it is worth recalling that the town at that time measured 2,000 yards from north to south and 750 yards from east to west, and was situated within fortifications consisting of a fort, a thick hedge and a deep dry ditch. It is stated that the streets were irregular, the fort was oval in shape with towers at intervals, and had two gateways, one in the north and the other in the south.

A significant development of this period is the origin of Lalbagh, which literally means red garden. Today, this garden covers an area of over 400 acres and is the chief attraction for tourists. It had a small beginning during the period of Hyder Ali, and was later nursed and developed by Tippu Sultan.

Origin of the civil station

An important development in the beginning of the 19th century, which is a contributory factor to the growing importance of the city, is the origin of the civil station.

In 1807, the then British India Government moved some troops from Srirangapatna and stationed them in the present cantonment area for reasons of health and climate. The stationing of troops in this area offered commercial and other employment opportunities and attracted civilian population to settle near about the area. The civil and military areas were under the control of the State Government till 1881. In 1881, after the rendition of the Mysore State, this area was handed over to the British India Government for direct administration. The ceding of this area to the Government of Mysore, after independence in 1947, is a recent development. A consequence of the direct administration of the area was the existence of two separate municipal administrations over two parts of what was in fact one city. Such a division was quite unnatural. After the ceding of this area to the Mysore Government, steps were taken to form a single municipal administration, and the Corporation of Bangalore was formed in 1949.

Railway connection

Bangalore was first linked by rail to Madras in the year 1864 when the broad gauge line was extended to the cantonment. Railway connections were established with Mysore in 1882, with Harihar in 1889 and with Guntakal in 1893.

Water supply and electric power

The city got its first protected water supply from Hesaraghatta tank in 1896. The Thippagondanahalli reservoir across the River Arkavathi was completed in 1933, and this has been the main source of water supply to the city since then.

Electricity for power and lighting was first switched on in the year 1905, the source being the hydro-electric generating station at Shivasamudram.

Growth of Bangalore

Advantageously located with regard to climate, communications and other facilities, the city has witnessed a steady growth since its small beginning. Coupled with the natural advantages, the rulers of the State have also evinced keen and sustained interest in the growth and prosperity of the city, with the result that it has grown in strength and has steadily increased in importance as an industrial and commercial centre.

Population

The population of the city is over 1,200,000 according to the 1961 census. For the purpose of the 1961 census, a few areas outside the Corporation limits were also included to form the metropolitan area of Bangalore. The growth of the city has been steady since the beginning of the century and almost phenomenal since 1941. The population in 1881 was 156,000. It increased to 180,000 in 1891, an increase of 18.3%. There was a slight fall in the population of the city from 1891 to 1901, but since 1901, it is steadily increasing. The population was 407,000 in 1941, which increased to 779,000 in 1951, an increase of 92%. The following are the important reasons for this abnormal increase:

(i) Military activities in and around Bangalore increased considerably during the war period, thus increasing employment opportunities;

(ii) The wartime needs gave a fillip to many existing industries, particularly silk and cotton. Other smaller industries also came up during the same period ; and

(iii) The Hindustan Aircraft Ltd., employing about 3,000 workers in the initial stages, came into being during 1941, partly for strategic reasons. The number of employees increased to 6,000 in 1951.

The rate of increase of population has reduced since 1951. The pressure of increasing population is felt not only within the area of the city but also beyond its limits. A correct picture of the pressure of increasing population will, therefore, be available only when we take a much larger area than the city itself, which may be called the region of Bangalore. One more contributing factor to the rapidly increasing population of the city is the formation of the new Mysore State with an area nearly 2½ times the area of the erstwhile Mysore State.

Circulation pattern

Bangalore is the focal point of rail and road networks in southern India and has direct rail links with a number of major towns and cities in the country.

Trunk roads connecting major cities and towns, such as Hubli, Poona, Hyderabad, Madras, Salem and Mysore radiate from the city in all directions. Two of these trunk roads are National Highways. Other important roads connecting district headquarters also radiate from the city.

Traffic within the city

With the increase in population and its increasing importance as a commercial, industrial and administrative centre, the traffic on the city's roads is increasing. The number of vehicles in the city is also steadily increasing ; there were about 6,900 vehicles in 1953, but now there are nearly 12,000.

Industries

Bangalore is an industrial city. About 32% of the population depended for their livelihood on industry in 1951. The figures for 1961 are still awaited, but this percentage must have increased because more areas containing predominantly industrial workers have been brought within the Bangalore metropolitan area for the purpose of the census. In industrialization, what is required is a good start. Industry follows industry, and once a good start is made in the industrialization of a particular area, other industries naturally follow.

In the city, the supply of cheap electric power from Shivasamudram hydro-electric works since 1905 has contributed most towards early industrialization. The Government of Mysore have also evinced keen and sustained interest in the industrialization of the city and have pioneered several industrial undertakings in fields where private enterprise was lacking or was inadequate to the needs of the situation. The Government have also helped private industrialists in starting new industries.

Engineering and textile are the major industries in Bangalore, each employing over 20,000 workers. The first major factory to be started in Bangalore was the Binny

Mills (1884), followed by the Maharaja Mills (1894) and the Minerva Mills (1919). The Government Electric Factory and the Government Porcelain Factory were started after 1930.

As mentioned earlier, the Hindustan Aircraft Ltd., which is the biggest factory in this area, started during the Second World War, employs over 12,000 workers. The post-independence era saw the coming into being of the Indian Telephone Industries (1948) near Krishnarajapuram, the Hindustan Machine Tools (1953), and the Bharat Electronics Ltd. (1954) near Jalahally.

The Hindustan Aircraft Ltd. has expanded considerably and added other units of production such as a rail coach factory, aero engine factory, etc. In all, there are over 500 factories of varying sizes in and around the city. Of these, nine factories employ more than 1,000 workers each and these account for over 50% of the total employment in the factories. Smaller factories employing less than 100 persons are by far the largest in number, as many as 450, though their employment potential is less than 50% of the employment provided by the major factories.

The location of industries in Bangalore is more due to the availability of the land and transport facilities than due to considerations of balanced development. Most of the factories are located along main highways and railways. There is no Master Plan to regulate the location of these industries. But, what is more surprising is the un-coordinated development of factories and their housing colonies by the Central Government such as the housing colonies of the Bharat Electronics Ltd., and the Hindustan Machine Tools. These two colonies are only about half a mile apart, but each has come up independently of the other. It would have been better if these two factories had together put up a small township on a planned basis with all the civic amenities for housing their staff.

Housing facilities

Housing is one of the important problems faced in any urban area, and more particularly in large towns and cities. Bangalore is no exception to this.

The population of the city is increasing so rapidly that the rate of building activity is always lagging behind and housing conditions continue to grow from bad to worse with the passage of time. There does not seem to be any hope of improvement in the housing conditions unless institutional housing on a large scale is taken up. There are some housing schemes such as the low income group, middle income group and subsidized industrial housing schemes in operation, but the progress achieved under these schemes is very small. While the housing shortage runs to over 100,000 dwellings, the progress in the housing schemes can be measured only in hundreds. Though there is considerable building activity in the private sector, but this is inadequate to meet the situation. Further, there is a large percentage of floating population requiring housing accommodation only for the short period of their stay in the city.

Earlier extensions to the city

Even by the end of the 19th century, the old city area had become congested and efforts were being made to reduce congestion in the city by laying out new extensions. The Government constituted several committees for general improvement of the city, culminating in the constitution of the statutory body, the City Improvement Trust Board, in 1945. The Board is charged with the task of carrying out improvement and future expansion of the city. The schemes undertaken by the Government achieved a fair measure of success in relieving congestion and overcrowding in the city till 1941. It was only after 1941 that the growth of population outpaced these developments and improvements.

Seshadripuram was the first area to be laid out, in the year 1892, followed by Chamarajapet, together covering an area of about 300 acres and containing 1,600 building sites. The expenditure on these two extensions is estimated at about Rs. 7 lakhs.

The Basavangudi extension to the south of Chamarajapet was developed in 1898. This was followed by the Malleswaram extension covering an area of 304 acres with 620 sites. The Gavipuram and Sriramapuram extensions were laid out in 1915-16. These covered an area of 100 acres.

Next, the Visveswarapuram extension to the south east of the city was laid out at a cost of Rs. 6 lakhs in 1918 and covering an area of 93 acres. This extension provided 467 building sites.

A few more new extensions were laid out between 1921 and 1940. The areas already laid out also took time to be completely built over. In all, the extensions laid out between 1892 and 1941 covered an area of about 1,680 acres and provided about 6,700 building sites.

Madhava Rao Committee

The Government constituted a committee under the chairmanship of Shri N. Madhava Rao in 1952 for preparing a development plan for the city. The committee did not have the assistance of special staff required for collecting the necessary data for preparing a Master Plan. So, they collected whatever data was readily available and submitted a report to the Government which was published as the 'Report of the Bangalore Development Committee', in 1954. The proposals made in the report were of an interim nature. No further attempt was made to prepare a Master Plan for this rapidly growing city till recently. Even the proposals made by the committee were not implemented in full. Further, they proceeded on certain assumptions which were later proved to be incorrect. For example, the committee estimated that the population of the city would be 900,000 in 1961 and 1,280,000 in 1991. But in 1961, the population had reached 1,200,000.

Approach to planned development

The city has been sprawling out in recent times without regard to the ill-effects of unplanned expansion. Preparing a layout or taking up a scheme is not a planned development. Though the population of the city and the consequent demand for developed land are increasing at a phenomenal rate, the method adopted to solve this problem is to develop land wherever it is available and allot small sites to individuals. In this way, the problems of water supply, underground drainage, efficient transport system, educational and recreational facilities within easy reach, etc., will multiply. Before embarking on land development on a large scale, it is necessary to find out the existing density and distribution of population and whether they are in the general interest of the community. For example, close to central areas, the existing density of population may be very low and steps for augmenting it may be necessary. Where density is high, steps have to be taken for reducing it, keeping in view the available civic amenities. Only after working out the over-spill population after making suitable adjustments in the existing density and distribution of population, the need for additional developed land should be worked out. Then only the development of land according to a definite programme should be taken up.

There is at present very little vertical development in this city. Very few houses are more than two storeys high while most of the houses are only single-storey and detached. This type of development will not solve our problems. It is difficult to achieve high density of population, which is quite necessary in a city of the size of Bangalore, with cottages and bungalows. While cottages and bungalows are also necessary, there should be a mixture of vertical development with horizontal development. Not only will such a mixture help in attaining reasonable density of population, but also will provide a better and more pleasing appearance to the town. Higher density can be achieved with single-storeyed development, but only at the expense of essential civic amenities such as parks and playgrounds. Such areas degenerate into slums in course of time.

An urgent problem confronting the city is the problem of water supply. Though efforts were being made by the Government to find a satisfactory solution to this pressing problem, the solution has always evaded the efforts. The Government have at present two schemes, before them the Hallimala scheme and the Cauvery scheme, for augmenting the city's present meagre water supply of about 10 gallons per capital per day.

The basic problem of our cities is to keep down the increase in population. Family planning alone will not solve this problem, though it may be successful in cities where the increase in population is more due to migration than due to natural causes such as excess of births over deaths. As such, the increase in the city's population can be kept down only by reducing the migration.

Several factors contribute towards migration from rural to urban areas and also from small to larger towns. Of these, two important causes are (i) lack of adequate employment opportunities in rural areas and small towns, and (ii) lack of adequate civic and social amenities. On one hand, it is to be ensured that additional employment opportunities are not created, no new industries are located and no new offices are permitted in the city; on the other hand, employment opportunities have to increased in areas from where migration is considerable. Better civic amenities have to be provided in rural areas and smaller towns. This means creating regional sub-centres to absorb the excess rural population so that the city, is not faced with the serious problem of rapid increase in population. The rural economy also needs to be stabilized to keep the rural-urban migration to the minimum.

A proposal is at present under consideration for the development of a few satellite towns around the city. Such a scheme needs careful study. The objective test for the success of such a scheme is the extent to which the city's population is moved out. Further, these towns should be sufficiently far from the main city so that they can develop without being dwarfed by the city. These new centres should also be made self-contained so that the daily needs of the inhabitants are satisfied there itself.

Bangalore is facing complex planning problems which need careful investigation. The Government have recently constituted the Bangalore Metropolitan Planning Board to prepare a Master Plan and to delineate the boundaries of the metropolitan region of Bangalore. A metropolitan region includes areas where the influence of the main city is felt to a considerable extent. It is difficult to define exactly what constitutes a metropolitan region, but the area could be delineated approximately after conducting some surveys. A metropolitan region is a convenient unit for planning. The urban units within the metropolitan region influence one another and exhibit definite urbanization trends.

Legislation

Planning implies a certain measure of control over the rights of the individual in so far as they relate to land and buildings. Persuation might have been sufficient in olden days to achieve the object of planned development. Planning is much easier in a totalitarian country where the community owns everything. But, in a democratic country such as India, the objective of planned development cannot be achieved without a legal enactment, giving adequate powers to the State and other agencies concerned with planning.

The Mysore Town and Country Planning Bill has recently been passed. If the provisions of this legislation are enforced by the local authorities, who are also the planning authorities under the Bill, without fear or favour, our villages, towns and cities will provide a better, happier and healthier environment for our people to live and work in.'

Uttar Pradesh Centre

Chairman's address by Shri Jagdish Prasad, C.E., M.I.E., at the 41st Annual General Meeting of the Centre on December 17, 1961.

The Chairman welcomed the Chief Guest, Maj.-Gen. Harkirat Singh, President, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

Delivering his address, Shri Jagdish Prasad said, 'We are in the 15th year since achieving independence. The Government have been striving hard to raise the general standard of living of the people by developing the economy in various spheres, so as to bring it in line with other progressive countries. The economic regeneration of a nation with a population of 400 millions, which has fallen into poverty and backwardness in course of centuries, cannot be achieved in one or two decade. However, a great deal of progress has been made as a result of the Five Year Plans. At the end of the First Plan involving an investment of Rs. 3,000 crores, the national income increased by 18% and the per capita income by 11%. Production of foodgrains increased by 20%. The

Second Plan, with an investment of over Rs. 6,000 crores, aimed at rapid industrialization and development of basic industries, expansion of employment opportunities, increase in national income, etc. In spite of the shortage of foreign exchange and inflationary pressures, the Second Plan has achieved a great deal of success. Considerable progress has been made in basic industries, mining, transport and power generation. The foundations for rapid industrialization have been laid. In Uttar Pradesh, the cement factory at Churk, the soda ash factory at Ramnagar near Varanasi, the aluminium factory at Rihand, the antibiotics factory at Rishikesh, the heavy electricals factory at Jwalapur and the fertilizer factory at Gorakhpur will put the State on the industrial map of India. A large number of smaller factories have also been set up during the Second Plan. The Third Plan, with an investment of over Rs. 10,000 crores, embodies the nation's determination to create a self-generating economy in the shortest possible time. Production of steel and minerals, machine building, development of power, irrigation and increase in food production have been allotted a large share of the total investment. A plan of such magnitude calls for sustained and coordinated efforts on the part of the different sections of the community, high level of administrative efficiency, minimization of cost of construction and economy and efficiency in running public enterprises.

In a large agricultural country like India, with over 700,000 villages and vastly varying topography, the highways have a dynamic role to play. They serve as arteries of the nation. The prosperity of the villager and the agriculturist depends to a great measure on the distance of the metalled and bridged road from his field or farm. We are far behind the advanced countries of the world with regard to our road system, and yet the funds available for road construction are most inadequate. The allocation for roads in the Third Plan is only about 2.5% of the total outlay, as against 5% in the First Plan and 4% in the Second Plan. In Uttar Pradesh, roads have been allotted Rs. 18 crores only in this Plan, which also includes Rs. 11 crores for completion of the schemes started in the Second Plan. The existing road system in the State is inadequate. because of unbridged crossings, substandard surface, insufficient crust and narrow carriageways. As a result of all-round development and increased economic activity during the last ten years, the traffic has increased many-fold but not the allocation of funds for roads. Uttar Pradesh has only 12.8 miles of metalled road for every 100 sq. miles of area, and 19 miles per 100,000 of population, as against the all-India average of 33 miles per 100,000 of population. In order that no place is more than four miles from a metalled road in developed and agricultural areas, more than eight miles in semi-developed areas and more than 12 miles in undeveloped areas, the mileage of metalled roads will have to be increased to 3.5 times the existing value. At the prevailing rate of construction, it will be impossible to attain this target in the next 20 years. The result will be that not only the progress of economic and social uplift of the villages will be retarded, but a serious bottleneck will occur in the movement of agricultural produce and consumer goods, keeping in view the future development of agriculture and industries.

It has been estimated that out of the existing 14,500 miles of metalled roads in the State, 4,270 miles need strengthening of crust to withstand the traffic. But, due to the low Plan ceiling, we can take up strengthening of only 570 miles in the Third Plan.

Nearly 4,000 miles of roads, which have water bound surface and carry over 500 tons of traffic daily, need black top surface to withstand this traffic. About 2,500 miles with painted surface, which carry over 1,500 tons of traffic daily, need widening to two lanes of traffic and strengthening of the surface by converting to bituminous or cement concrete. All this will require large amount of money which will have to be found, sooner or later, if roads are to be preserved. In the Second Plan, reconstruction and improvement of 1,684 miles of road was taken up, of which 1,167 miles were completed. The remaining will be completed in the Third Plan. Under the new schemes of the Third Plan, reconstruction and improvement of 682 miles will be taken up, of which 340 miles can be completed with the funds available. As regards construction of new roads, 3,298 miles were taken up in the Second Plan, of which 1,800 miles were completed. The remaining will be completed in the Third Plan. Under the new schemes of the Third Plan, it is proposed to take up construction of 582 miles of new roads and to complete the construction of 240 miles during the Plan period.

Absence of bridges on most of the rivers is a great obstacle in the movement of traffic. Construction of 148 bridges was undertaken in the Second Plan, of which 62 bridges were completed by the end of that Plan. The remaining bridges have been carried over to the Third Plan. Besides, 16 new bridges have been included in this Plan. These will, however, meet only a fraction of the requirements of the State.

For rapid industrialization and development of agriculture, power is required. The State is not very fortunate in natural fuel resources. We have, therefore, to harness the rivers for generating power. By the end of the Second Plan, the State had about 400 MW installed power capacity. The State Irrigation Department has completed a 304 ft. high concrete dam over the Rihand River at Pipri, costing about Rs. 46 crores. The energy of water collected behind the dam will be utilized for generating 250 MW, and this power will be supplied to the eastern and south-eastern districts of the State. This scheme will also provide irrigation facilities and navigation in the Sone River and reduce flood ravages in that river. The Yamuna hydel scheme in Dehra Dun District envisages construction of three power stations having an installed capacity of 320 MW for providing power to western districts. Under the Matatila hydel project, a power station with installed capacity of 30 MW will be set up for providing power to the Bundelkhand area. The Ramganga project envisages installation of a 127 MW power station, and the Obra project a 100 MW power station. Besides, the steam power station of Harduaganj is being extended to provide two steam generating sets of 30 MW each. The old generating set of 20 MW will also be replaced by a new 30 MW set. Under the rural electrification scheme, it is proposed to electrify 1,500 towns and villages, give supply to about 4,000 rural consumers and 750 private tube-wells. To reduce the cost of power schemes, it is necessary that the manufacture of electrical machines and equipment required for power generation is started in this country. It is hoped that this difficulty will be overcome to a large extent when electrical generating sets and other electrical equipment are produced by the Heavy Electricals Ltd., in Bhopal and in the proposed new factory at Ranipur, by the end of the Third Plan.

The State Public Health Engineering Department has launched a big programme of urban and rural water supply, sanitation and sewage utilization to achieve healthier living conditions for the people. It is proposed to provide water supply to 37 new towns at an estimated cost of Rs. 2.7 crores and drainage schemes in 36 towns at a cost of Rs. 2.28 crores. Under spillover schemes, the Plan provides for water supply to 24 towns at a cost of Rs. 3.57 crores and drainage in 11 towns at a cost of Rs. 1.91 crores. In rural areas of hilly districts, a number of water supply schemes will be taken up. Rural sanitary schemes will also be taken up in the Meerut District. These schemes will cost about Rs. 2.7 crores. Besides, a large number of rural schemes are likely to be taken up under the community development programme. Sewage utilization schemes will cover 10 large towns and are estimated to cost Rs. 50 lakhs.

In advanced countries, considerable importance is given to practical training of engineering graduates. No engineering institution, howsoever well equipped, can produce engineers who could be entrusted straight away with the execution of important projects. Unfortunately, apprenticeship schemes have not received the attention they deserve in the country. In engineering departments of the Government which recruit a large number of engineers each year, it is necessary to put a special officer in charge of the apprentices to arrange for their programme of training in works under execution, maintenance of existing structures, and use of mechanical equipment and their maintenance. He should examine notes on works, clarify doubts, explain how pitfalls should be avoided, quality checked, esitimates prepared and work measured, accounts maintained and a new project planned and organized. He should also give instruction on legal matters pertaining to contracts, human relations, public dealings and conduct rules. A young engineer left to himself will take several years to learn these things. On his training in a systematic and scientific manner will depend the standard of efficiency that can be attained in the execution of future Plans.

Scientific knowledge is developing so rapidly that the concepts of today may be discarded for new concepts of tomorrow. In this fast changing and highly competitive world, the need of continuing one's education is greater than ever before. Even in a limited branch of engineering or technology, it is difficult to keep up the pace of education with the developments. It is a matter of satisfaction, therefore, that the University of Roorkee has introduced specialist and refresher courses for serving engineers in the various branches of engineering. These courses are of great benefit to serving engineers.

Technical education will receive increasing impetus in the Third Plan. The intake capacity of engineering colleges and polytechnics will increase from 37,000 at the end of the Second Plan to 52,500 at the end of the Third Plan. The engineering universities and technical colleges will continue to play an increasingly important role in the technological and industrial development of the country. Our achievement in this development will, to a great extent, depend on the calibre of the products of these universities and colleges, which will in turn depend on the learning, ability and practical experience of the teachers. Teachers should spend some time in construction jobs and industrial undertakings to keep themselves up-to-date. An exchange of teachers of technical institutions with executives in technical fields will improve the knowledge of both and encourage creative thinking, which is essential for the advancement of the country.

An engineer-administrator is in a more advantageous position in dealing with day-to-day problems arising during the execution of an engineering or industrial project than a non-technical administrator. It would, therefore, be in the interest of technological and industrial advancement of the country that the best brains are diverted to the engineering profession. The country needs more engineers of high calibre than administrators. Engineering talent should be developed and engineering services made more attractive. An All-India Service of Engineers with pay scales equal to those of the Indian Administrative Service should be introduced and the education and training of engineers should be given the highest importance.

Every nation lays great emphasis on research in science and technology. Adequate facilities for research should be provided in engineering universities and industrial undertakings, so that specialization is possible in planning, design and construction in the country and we do not have to depend on foreign consulting engineers. Research takes time and pays dividends only when it is continued and is handled by persons who have creative talent, originality and imagination. The selection of research staff, therefore, needs care, and once the best men have been picked out, they should be retained by giving them reasonable emolument and incentive. There are, in this State four engineering research institutes, *viz.*, the Central Building Research Institute, the Irrigagation and Hydraulic Research Institute at Roorkee, the Railway Research Institute, and P. W. D. Research Institute at Lucknow. The Irrigation and Hydraulic Research Institute has been working for the last 12 years and has done useful work in the design of spillways, protection of towns from river erosion, earthen dams, foundations, etc. The P. W. D. Research Institute has devoted considerable time to testing of local materials to determine their suitability for construction of roads, bridges, and buildings. After conducting necessary tests, it has suggested methods for strengthening road foundations, improving adhesion of bitumen to stone or brick ballast, stabilization of soil for road making, making bricks from highly shrinkable soils, waterproofing of ordinary plaster, application of non-erodable mud plaster for kutcha walls, etc. The Central Building Research Institute has done useful work in regard to the properties of building materials, shell structures, improvements in steel reinforcing bars, prestressed concrete, design of foundations in black cotton soils, heat transmission through walls and roofs, etc.

The developments in various branches of engineering taking place in advanced countries come to us through the medium of engineering publications and journals. To enable the members of the Institution to keep themselves informed about the latest developments, a library and reading room has been established at this Centre at Lucknow, but it requires considerable expansion. The library has only about 1,900 books, which is a very small number, considering that it has to meet the needs of engineers in all branches of engineering.

Before closing my address, I would ask engineers to feel proud of being members of a profession which can render the greatest service to the country. By our integrity, sound judgment, endurance and devotion to duty, we should enlist the cooperation and win the confidence of the public whom we serve. We should set an example to other services by conscientiously, diligently and selflessly carrying out our duties to the best of our abilities, so that the country may soon become self-sufficient, prosperous and strong, and may take a place of pride amongst the nations of the world.'

Summaries of Papers Published in the Journal, vol. 42, no. 11, pts. CI 6, ME 6, & MM 3, July 1962

CIVIL ENGINEERING DIVISION

Reinforced Concrete Chimney Stack at Trombay—1. Investigations on wind-induced vibrations and 2. Construction

S. Arunachala Reddi
Associate Member

The first part of the paper deals with the investigations on wind induced vibrations in the case of a 400 ft. high R.C. chimney stack constructed at Trombay, built as part of the Canada-India Reactor. The stack conveys and discharges into atmosphere the effluent gases from the reactor. The stack is located about 400 ft. away from the reactor building. As the effluent gases would be slightly radioactive, the stack height had to be fixed in the context of a possibility of inversion of the contaminated gases into the immediate locality before the radioactivity reduces to safe limits. A height of 400 ft. was decided upon after taking into account the wind conditions in the area, the layout and height of adjacent structures, and the effluent velocity. This stack is believed to be the tallest structure of its kind yet constructed in India. The construction features of the stack are discussed in thé second part of the paper.

Foundations for Reciprocating Types of Machines

H. A. Balakrishna Rao
Non-member

The natural frequency of a foundation-soil system is shown to be a function of the total static load. It is also established that the natural frequency can be predicted based on the density-pressure bulb concept and utilizing Boussinesq's equation. This paper presents an extension of the density-pressure bulb concept for the design of the foundation block for a reciprocating type of machine. Two methods have been developed : (i) one consisting of trial and error ; and (ii) the other the derivation of a cubic equation which has only one positive real root and thus a unique value for the mass of the machine foundation block. The paper also reviews some of the existing literature on the design of machine foundations.

Expansive Sub-Critical Flow in Open Channel Transitions

R. S. Chaturvedi
Non-member

In spite of extensive and increasing use of flumed structures for conveyance of water in open channels, the design of rational transitions in an expansive flow has withstood every effort towards a general solution. It remains an unsolved problem in fluid mechanics. The emperical methods in use (no doubt, they yield qualitative results) are not completely dependable even after thorough experimentation, as the expansive flow is not completely reproduced in a model under the Froude criterion. The existing analysis so far has provided only a physical picture of the controlling factors whose quantitative assessment is still beyond the reach of the engineers. Amongst these factors, the author proposes that the lateral velocity variation presents the most important characteristic of a transition.

The proposed transition formula is evolved logically and scientifically based on a systematic model experimentation and is self-evident under the assumptions made. The recommendation is not, however, made merely on the basis of tests described in this paper. A review of the literature on the valuable attempts of several other pioneers in the field, together with the author's work on design and critical examination under field conditions, have gone towards the framing of these conclusions. They bring out only a part of the solution, *viz.*, the optimum geometry of expansive sub-critical transitions.

The proposed sub-critical expansive transition has the justification of rigorous mathematical derivation under the assumptions made and the support of extensive laboratory examinations. In spite of the apparent simplification of the complex problem, the above formula would yield a more dependable and easier solution than available at the moment with the one-dimensional approach which involves doubtful approximations and arduous mathematical computations.

Maximum Flood Discharge

K. B. Khushalani

Non-member

Since the consequences of under-estimating flood discharge are serious while its over-estimation entails extravagance, determination of the maximum discharge for any river up to the point of a structure which has to pass that flood is a ticklish and controversial question. Much to our dislike, various flood formulæ hold the sway and on that score, frequent efforts have been made from time to time to evolve a formula out of the local data and use it in preference to others which applicable to other regions.

All the flood formulæ now used in India give discharge in terms of the catchment area, and except for the Inglis formula, the other formulæ do not have a constant which has fixed in value. The designer is always in a dilemma with regard to the constant and seldom two hydrologists agree on its value. The main aim in this study is to explain that personal judgment should be curtailed and higgling or speculation on the constant should be done away with.

Design of Trash Rack Structures

M. Kothandaraman

Associate Member

Trash rack forms an integral part of intake structure of hydro-electric power plants. The type, shape and size of a trash rack depend on its accessibility for repair, the size and amount of trash expected, and the fluctuations in the reservoir level. In this paper, the basis for hydraulic design of trash rack and its supporting structure is briefly described, and typical design calculations are given to illustrate the method.

The Port of Calcutta—Problems and Solution

D. Mookerjea

Member

The Port of Calcutta is by far the largest and most important port in the north-eastern part of India. To ensure its retention as a first class international port and also to cater for the anticipated increase of trade due to rapid industrialization of the country, it has become essential to take immediate effective long term measures for saving the port from gradual and complete extinction due to the continued deterioration of the navigable approaches of the Hooghly River.

The solution to this problem lies in the diversion of upland water in the season when the silt charge in the head water is comparatively less. The upland water during the non-freshet season would flush out the port of Calcutta and offer additional draft for navigation purposes. This can be made possible only by the construction of a barrage across the Ganga at Farakka and diversion of as much silt free non-freshet flow down the Bhagirathi River as feasible.

Planning for Flood Control Legislation

Moshin Ali

Member

A study of the history of flood damage is very revealing, in as much as it shows that the phenomenon is of universal occurrence. As a result of the unprecedented rate of population growth and the terrible pace of urbanization, a senseless and uneconomic use is being made of floodways and flood plains. Consequently, it is found that the cost involved in flood destruction is not only increasing every year, but the floods are reaching higher and higher peaks and extending over wider areas. The flood problem to which not much thought has been given in the past calls for immediate and suitable legislative action in India and Pakistan.

Porbandar Harbour Expansion

H. P. Oza

Member

Porbandar is on the west coast of the Saurashtra peninsula on the Arabean Sea, about 250 miles northwest of Bombay. The port is classified as an intermediate port and handles a traffic of the order of 150,000 tons per annum. The port is known for its passenger traffic from and to African ports, and is a fair weather open roadstead with the steamer anchorage about one mile from the shore. The harbour is built in the mouth of a small river, the Asmavati, but the river is now bonded off and has no practical influence on the port.

For almost 60 years, no civil construction work of any significance was undertaken. For the growing port of Porbandar, a breakwater for protecton during the southwest monsoon will be inevitable. Deepening of the entrance channel also will have to be undertaken. This paper is a record of the progress made, and details the main technical features of the works and the adaptation of designs to suit local requirements. Construction costs are given as they would be of use to other engineers contemplating similar works.

Graphical Method of Drawing Flow Net Diagram for a Flat Foundation Infinite Depth Permeable Soil Stratum

V. G. Palnitkar

Non-member

The flow net diagram described in this paper consists of confocal ellipses and hyperbolae, being respectively the stream lines and the equipotentials. The diagram can be formed from analytical equations or may be constructed graphically. In this paper, an exact graphical method is evolved, making use of some striking properties of the flow net, which is first established by an analytical solution.

Influence Lines for Fixed Symmetrical Portals by Relaxation Method

Prakash Desayi

Graduate

The usual methods of analyzing a fixed portal, specially of varying section, are laborious and time consuming. This paper presents a simple numerical procedure for determining the influence lines for the three statical indeterminants, *viz.*, vertical reaction, horizontal thrust and fixing moment, of any fixed symmetrical portal, and thus equips the engineer engaged in the analysis of such a structure with a method by which he can finish his work quicker and with less labour. An example is also worked out to illustrate the procedure.

Economical Design of Beams

K. V. Rao

This paper deals with a new method of design of beams, adopting the theory of cantilevered and interjected beams to the fullest advantage. The proposed method of design is much more economical than the designs based on present day practices.

One-Dimensional Consolidation of Layered Soils

A. Sridharan

Non-member

and

T. S. Nagaraj

Non-member

The settlement of a structure founded on a compressible stratum of soil is now being predicted by Terzaghi's theory of one-dimensional consolidation. Not much work has been done on the characteristics of one-dimensional consolidation of layered system of soils. In this paper, the behaviour of two-layered soils under one-dimensional consolidation is presented. The paper also gives a description of the remoulding of two or three layers of soils in the oedometer ring.

Vertical Sand Drains—1. Uses and Construction and 2. Theory and Design

J. K. Sridhar Rao
Non-member

and

Prof. R. G. Hennes
Non-member

Vertical sand drains appear to hold the greatest promise for stabilization of swamps for road construction and land reclamation. Vertical sand drains shorten the settling time and minimize differential settling. In the first part of this paper, the authors have attempted to bring forward the functions, constructional details, uses and importance of control measures, economy, and the limitations and applicability of the vertical sand drain technique to Indian conditions. Also, a short note on the modern developments in vertical sand drain techniques is added. Vertical sand drains thus serve as a useful tool in foundation engineering.

The second part of the paper is concerned with theoretical concepts of two- and three-dimensional radial drainage, and the factors to be considered in the design of vertical sand drains. Among the topics treated are the spacing and size of sand drains, peripheral smear, wall friction, and the contrasting influences of horizontal and vertical permeability. An illustrative problem serves to emphasize the value of these sand-filled wells in hastening the subsidence of embankments resulting from the consolidation of underlying marshy soils. Original charts facilitate design of vertical sand drainage systems. Another original feature permits easy determination of the coefficient of consolidation of marshland for horizontal radial ground water flow.

Optimum Design for the Scroll Case of a Reaction Turbine

D. S. Srinivasa
Non-member

A formula for the hydraulic design of scroll cases is presented in this paper. The formula is derived taking into consideration the secondary flow in the boundary layer in the scroll casing. The proposed design method ensures minimum frictional loss in the scroll casing and an equitable distribution of inflow to all the runner blades.

STRUCTURES GROUP—2 SHELL STRUCTURES

Analysis of Edge Disturbances in Circular Cylindrical Shells

S. K. Mallick
Non-member
S. Singh
Non-member
and
P. C. Bhargava
Non-member

In a previous paper, Holand's 'new approximate theory' for the edge disturbances in circular cylindrical shells was introduced and the numerical procedure was illustrated by an example. In this paper, the edge conditions for single span, simply supported shells of various types, *e.g.*, multiple barrel shells, single or multiple shells with edge beams, north-light shells, etc., are discussed and the basic equations presented. In practical designs, the analysis is very much simplified by the extensive design tables given by Rudiger and Urban and in the ASCE Manuals. The analytical work is not more complicated or lengthy than the analysis of a major statically indeterminate structure. The matrices can be conveniently obtained on a calculating machine.

PUBLIC HEALTH ENGINEERING GROUP

A Comparative Study of the M.P.N. and Membrane Filter Techniques for Bacteriological Examination of Drinking Water

Prof. S. J. Arceivala
Associate Member
and
R. Pitchai
Associate Member

Since 1950, a new procedure called 'membrane filter technique', first developed in Germany and subsequently introduced in the U.S.A. by Goetz and Tsuneishi in 1951, has come into practice in the bacteriological analysis of water. Since 1960, this method has been designated as a standard method alternative to the multiple tube fermentation procedure, which reports the result either as a 'coliform index' or as a 'most probable number (M.P.N.)', the latter being preferred due to its relatively greater statistical precision.

The aim of the present work is to investigate how the membrane filter technique compares in its precision with the fermentation tube M.P.N. method and to familiarize the technique in order to evaluate its possible scope in the routine analysis of water in India. For this purpose, nearly 200 samples were tested using the two techniques, and the results subject to statistical analysis.

A Comparative Study of Natural Purification of Flowing Sewage in the Sewage Farms at Ahmedabad and Bangalore

Dr. S. V. Ganapati

Non-member

and

M. V. Bopardikar

Non-member

The purification of flowing sewage in the cities of Ahmedabad and Bangalore is brought about mainly by photosynthetic oxygenation rather than by atmospheric oxygenation resulting from violent agitation as in activated sludge plant. The paper gives a note on the several aspects of natural purification of sewage in the two cities such as : (i) physiographical aspects (ii) physico-chemical, aspects (iii) zones of pollution and natural purification, and (iv) factors influencing self-purification.

Micromeritics

Dr. G. C. Ghosh

Associate Member

Micromeritics is the technology of small particles. It is of recent origin and has applications in the fields of soil physics, mineral physics, chemical engineering, geology, wind storm study, hydrology, etc. In this paper, its importance in the field of public health engineering is discussed.

Concept of Self-Cleansing Velocity in the Design of Sewers

G. S. Raghavendra

Non-member

The design of a sewer is governed by several aspects : (i) the laws of open channel flow, (ii) conformity with the fact that the flow in the sewer is unsteady and non-uniform, and (iii) conveyance of suspended solids along with the flow to prevent their deposition in the sewers. As the first requirement can be easily satisfied and the second can be conveniently ignored in all ordinary designs, it is important for sewer designers to have a clear concept of two factors, *viz.*, 'self-cleansing' and 'self-cleansing velocity'. These concepts are discussed in the paper and their application to the design of sewers is indicated.

ROADS AND ROAD TRANSPORTATION GROUP

A Study of Indian Blast Furnace Slag as Road Aggregate

I. P. Khanna

Non-member

and

V. Venkatasubramanian

Associate Member

Indian iron industry produced about 4,680,000 tons of steel during 1960-61 which also meant a production of about 2,000,000 tons of blast furnace slag. The storage and disposal of this large deposit of slag presents a formidable problem. Proper use of this slag will not only reduce stockpiling near the steel plants but will help to reduce the price of pig iron. The paper presents the results of an investigation into the physical and chemical properties of two samples of Indian blast furnace slag, with a view to its use as a road aggregate.

MECHANICAL ENGINEERING DIVISION

A New Method for Determination of Proper Pulsations Corresponding to Torsion Vibrations of Crankshafts of Homogeneous Motors in Line

Andrei Ripianu

Non-member

Determination of the proper pulsations of vibrations of torsion of crankshafts, which presents in the construction of motors an exceptional and important case, is generally done based on the analytical method given by Holzer-Tolle, which involves laborious calculations due to the number of probes that must be effected to obtain with precision the value of the proper pulsations. The larger the number of masses, the more laborious are the calculations. For this reason, new methods of calculation have been searched into that permit the deduction of proper pulsations with no probes, and in this paper is described one such new method.

A Survey of the Status and Development of Free Piston Gasifier Turbine Prime Mover

A. Mangapati Rao

Non-member

This paper gives a review of the progress with regard to the free piston gasifier turbine power plant, its problems and its future possibilities for marine, loco and tractor applications. Its particular importance in the manufacture of heavy Diesel engines for medium power requirements and marine power plants in India is briefly discussed. The principal development problems and the features of design of fuel injection equipment, starting and control equipment, etc. are also briefly surveyed.

Calculation of Dovel Pins

F. Strasser

Non-member

Dovel pins are machine elements widely used for several purposes, chiefly for aligning (positioning two mating parts, locking against turning, as hinge pivots, etc.) and for joining. Usually, their dimensions are practically immaterial, so they are determined simply by judgment and estimation. However, in many cases, they are employed also for transmission of forces and then, they must be correctly calculated (checked for strength) in order to resist the stresses to which they are subject. In this paper, a comparatively simple method for the practical calculation of dovel pins for the most usual cases is described.

MINING & METALLURGY DIVISION

Some Important Non-Ferrous Metal Alloys and Their Development

U. P. Mullick

Member

This paper gives an account of the existing ore reserves in India and uses of non-ferrous metals such as aluminium, magnesium, beryllium and titanium and their alloys. On completion of the Third Five Year Plan, the production of aluminium in the form of sheets, wires, rods, extruded sections and foils is expected to be 82,500, 50,000, 30,000, 10,700 and 7,500 tons respectively.

Magnesium sources in India are found to occur in the chalk hills in Salem and Frazerpet in south Mysore, and in the salt lake bitterns and dolomite deposits in Birmitrapur. The use of magnesium enables a weight reduction of about 40% as compared with aluminium alloys. It is highly resistant to failure by fatigue, and is not subject to embrittlement when in use. Wrought alloys are used for extruded rods, base sections, tubes, etc. For forgings, zinc is added. In the cold state, it is soft and malleable to some extent, but more so when heated up to 300°C. It has low creep and rupture strength and shows grain coarsening at high temperature. The metal has compatibility with uranium, and the alloy 'magnox Al2' has been used in Calder Hall reactor.

Beryllium is used as a moderator and reflector in atomic reactors and as a canning material with certain reservations. The metal has good compatability with CO_2, uranium, and liquid metal up to 500°C., shows excellent irradiation resistance after intense bombardment when its mechanical properties are unaffected but the ductility is reduced.

Titanium, since 1950, is being used in the manufacture of jet aircraft in the U.S.A. Its production in India has yet to be developed. Its density is between that of aluminium and iron. At low temperatures, it is inert, and at high temperatures, it is reactive and readily absorbs oxygen. Among the alloys of titanium, A (alpha), B (beta) and C (alpha and beta), the first possesses moderate contamination resistance and good forgeability, toughness at high temperatures, and good weldability characteristics.

A Discussion on the Reduction of Silicon Dioxide in Blast Furnace

A. T. Pal

Associate Member

There are many factors which should be taken into consideration while studying the reduction of SiO_2 and the production of silicon-bearing iron in the blast furnace, but the most important amongst them are the temperature, the basicity of the slag and the thickness of the layer of slag over the metal. The paper discusses the influence of these factors illustrated by graphical results.

INSTITUTION NOTICES

Application forms for Sections A and B of the Associate Membership Examinations to be held in November 1962

Application forms for Sections A and B of the Associate Membership Examinations (existing scheme) to be held in November 1962 are attached to this issue of the *Bulletin*. The programme of the examinations and the detailed instructions are also attached with the application forms, and they may be detached for reference, if so desired. All these forms, programme of examinations and detailed instruction are **printed on white paper** to distinguish them from those applicable to the new scheme which are printed on pink paper (see notice below). Students are notified that no further application forms will be distributed to them.

All applications accompanied by examination fees for admission to the November 1962 examinations and two copies of passport size photograph should reach the Head Office before 12.00 noon on Saturday, September 15, 1962.

New scheme for Sections A and B of the Associate Membership Examinations

The Council have decided to introduce the new scheme for the Associate Membership Examinations in Sections A and B with effect from the November 1962 examinations. The details were already given on pages 36 to 41 of the November 1961 *Bulletin*.

Application forms for Sections A and B of the Associate Membership Examination (new scheme) to be held in November 1962 (**printed on pink paper**) are attached to this issue of the *Bulletin*. The programme of the examinations and the detailed instructions (**printed on pink paper**) are also attached with the application forms they may be detached for reference, if so desired.

Application form accompanied by examination fees for admission to the November 1962 examination (new scheme) should reach the Head Office before 12.00 noon on Saturday, September 15, 1962.

The detailed syllabuses will be available in the new booklet 'Rules and Syllabuses', now available for sale at Rs. 2.50 nP. per copy, postage extra.

Candidates will note that some minor alterations in the titles of some of the subjects (a list of which was given on pages 36 to 40 of November 1961 *Bulletin*) have been carried out and the list of subjects given below includes all these alterations in the titles.

The 'procedure for the introduction of the new scheme' is explained in the last paragraph of this notice, and Students are particularly asked to study it very carefully.

Candidates intending to appear in Section A examination will be required to take the following 8 subjects :

	Subject		Marks
1.	Mathematics I	..	100
2.	Mathematics II	..	100
3.	Applied Mechanics	..	100

4.	Principles and Applications of Electricity	.. 100
5.	Heat, Light and Sound	.. 100
6.	Engineering Drawing	.. 100
7.	Strength of Materials	.. 100
8.	Elementary Surveying	.. 100

Candidates intending to appear in Section B examination will be required to select any one of the following 7 branches of engineering. Candidates will have to appear in 9 subjects—7 compulsory and 2 optional.

1. Civil Engineering

(a) *Compulsory*

1. Materials and Construction
2. Theory and Design of Structures
3. Structural Engineering
4. Surveying and Geodesy
5. Hydraulics
6. Geology
7. Civil Engineering Design and Drawing

(b) *Optional* (any two)

8. Irrigation Engineering
9. Architecture
10. Soil Mechanics and Foundation Engineering
11. Railways
12. Agricultural Engineering
13. Public Health Engineering
14. Town Planning
15. Highway Engineering
16. Harbours and Docks
17. Thermodynamics and Heat Engines
18. Water Power Engineering
19. Production Technology and Industrial Engineering
20. Industrial Administration

2. Mechanical Engineering

(a) *Compulsory*

1. Mechanical Engineering Materials
2. Thermodynamics and Heat Engines
3. Industrial Organization and Managemnet
4. Workshop Technology
5. Hydraulics and Hydraulic Machinery
6. Theory of Machines
7. Mechanical Engineering Design and Drawing

(b) *Optional* (any two)

8. Production Technology
9. Thermal Power Engineering
10. Industrial Engineering
11. Refrigeration
12. Air-Conditioning
13. Water Power Engineering
14. Aerodynamics
15. Railway Locomotives and Rolling Stock
16. Automobile Engineering
17. Agricultural Engineering
18. Railways
19. Utilization of Electric Power
20. Metallurgy of Iron and Steel

3. Electrical Engineering

(a) *Compulsory*

1. Electrical Engineering Materials
2. General Mechanical Engineering
3. Electrical Measurements
4. Theory and Performance of Electric Machines
5. Generation, Transmission and Distribution of Electric Power
6. Industrial Administration
7. Electrical Engineering Design and Drawing

(b) *Optional* (any two)

8. Utilization of Electric Power
9. Production Technology and Industrial Engineering
10. Electric Traction
11. Illumination Engineering
12. Line Communication
13. Radio Communication
14. Hydro Power Engineering
15. General Electronics
16. High Frequency Currents
17. Agricultural Engineering
18. Thermodynamics and Heat Engines
19. Thermal Power Engineering
20. Principles of Line and Radio Communication

4. Chemical Engineering

(a) *Compulsory*

1. Chemical Engineering Materials
2. Industrial Stoichiometry and Mechanics of Fluids

3. Size Reduction, Mixing and Separation
4. Principles of Heat Transmission and Furnaces
5. Diffusional Processes, Evaporation and Distillation
6. Fuels and Combustion
7. Chemical Engineering Design and Drawing

(b) *Optional* (any two)

8. Elementary Electrical Engineering
9. Thermodynamics
10. Gas Engineering
11. Materials and Mechanical Construction of Chemical Plants
12. Metallurgy
13. Refrigeration and Air-Conditioning
14. Chemical Works Organization and Management
15. Geology
16. Thermal Power Engineering
17. General Mechanical Engineering
18. Metallurgy of Iron and Steel
19. Heat Treatment of Metals and Alloys

5. Mining Engineering

(a) *Compulsory*

1. Principles and Practice of Coal Mining
2. Principles and Practice of Metal Mining
3. Mine Ventilation, Explosions, Fires and Inundation
4. Mine Surveying
5. Mineral Dressing Practice
6. Mining Geology
7. Mining Machinery

(b) *Optional* (any two)

8. Generation, Distribution and Utilization of Power in Mines
9. Mine Design and Planning
10. Mine Organization and Management
11. Mine Economics
12. Metallurgy and Assaying
13. Fuels and Refractories
14. Drilling Engineering
15. General Mechanical Engineering
16. Size Reduction, Mixing and Separation
17. Metallurgy of Iron and Steel
18. Non-ferrous Metallurgy

6. Metallurgical Engineering

(a) *Compulsory*

1. Metallurgy of Iron and Steel
2. Non-ferrous Metallurgy
3. Mineral Dressing
4. Physical Metallurgy and Physical and Mechanical Testing of Metals
5. Refractories
6. Foundry Engineering
7. Heat Treatment of Metals and Alloys

(b) *Optional* (any two)

8. Metallurgical Analysis
9. Industrial Metallurgy
10. Physics of Metals
11. Metallurgy of Less Common Metals
12. Metallurgical Thermodynamics
13. Engineering Metallurgy
14. Electrometallurgy and Hydrometallurgy
15. Fuels and Furnaces
16. Workshop Technology
17. General Mechanical Engineering
18. Thermodynamics
19. Principles of Heat Transmission and Furnaces
20. Size Reduction, Mixing and Separation

7. Electronics and Telecommunication Engineering

(a) *Compulsory*

1. Electronics and Telecommunication Materials
2. General Electrical Engineering
3. Principles of Line and Radio Communication
4. Applied Electronics and Circuits
5. Transmission Lines and Networks
6. Advanced Radio and Electronic Engineering
7. Electronic and Telecommunication Design and Drawing

(b) *Optional* (any two)

8. Antenna and Wave Propagation
9. Radio Communication Systems
10. Audio Frequency Engineering
11. Electronic Measurements
12. Industrial Electronics
13. Radar Engineering and Microwave Techniques
14. Television

15. Telegraphy and Telephony
16. Carrier Current Engineering
17. Principles of Semiconductors and Transistor Circuits
18. Servomechanisms
19. General Mechanical Engineering
20. Production Technology
21. Electrical Measurements
22. Industrial Administration

The minimum mark for exemption from future examination in any subject is 50.

The pass mark in any subject is 35. But, if the overall (final) result is 'Failed', exemptions from future examinations will not be granted unless the mark is 50 or above in the subject or subjects concerned.

The papers of Section A (eight in number) may be taken by the examinees one or more at a time, but an aggregate of 400 marks for the whole Section of the examination and not less than 35 marks in each paper shall have to be secured for a final pass in the Section.

The papers of Section B (nine in number) may be taken by the examinees one or more at a time, but an aggregate of 450 marks for the whole Section of the examination and not less than 35 marks in each paper shall have to be secured for a final pass in the Section.

Procedure for introduction of the new scheme

1. The new scheme of examinations will be introduced from November 1962, and the existing scheme and new scheme of examinations will run concurrently up to November 1964.
2. Candidates wishing to appear for the first time in Section A or Section B, or those who have not secured any exemption previously under the existing scheme, will be given option to appear under the existing or new scheme of examinations up to November 1963. If such candidates fail to secure exemption in any subject of the existing scheme by November 1963, they will have to appear in the respective Sections under the new scheme from May 1964.
3. Candidates securing one or more exemptions in Section A or Section B under the existing scheme in November 1963 examinations or earlier, will be permitted to appear in the respective sections under the existing scheme up to November 1964.

Proposed Symposium on 'Civil Engineering Construction and Materials' at the 43rd Annual Convention, Bangalore

It is proposed to hold a Symposium on 'Civil Engineering Construction and Materials' during the 43rd Annual Convention of the Institution in early February 1963, at Bangalore. Members are requested to contribute papers on any one of the topics mentioned below or any other topic of their choice :

1. Materials technology
2. Materials
3. Standardization in engineering construction
4. Standardization in the use of engineering materials
5. Prefabrication in construction
6. Machines used in engineering construction
7. Organization of construction
8. Methods of executing works : (i) departmental system, (ii) cooperative labour system, etc.
9. Planning in construction of projects
10. Role of productivity in construction
11. Methods of improving efficiency in construction methods
12. Methods of improving speed in construction
13. Ensuring safety in construction
14. Legal aspects of execution of works
15. Cost accounting in construction
16. Methods of financing works
17. Research in materials and construction

Intending contributors may kindly communicate their assent to Prof. N. S. Govinda Rao (*M.*), Chairman, Civil Engineering Division, and Professor of Civil & Hydraulic Engineering, Indian Institute of Science, Bangalore 12. The synopsis of the papers should be sent by September 30, 1962, and the full text by November 30, 1962.

Renaming of the 'Industrial Management and Production Engineering Group' to 'Industrial Engineering Group'

As decided by the Council in their 425th Meeting held at Bombay on May 20, 1962, the 'Industrial Management and Production Engineering Group' has been renamed 'Industrial Engineering Group'.

Expulsion of Sarvashri B. N. Kashyap and K. K. Kaul from the Institution

As decided by the Council in their special 423rd and 424th Meetings held at Bombay on May 20, 1962, Sarvashri B. N. Kashyap (*A.M.*) and K. K. Kaul (*Student*) have been expelled from the Institution under the provisions of Bye-law 25.

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standard Specification for Bottom Shaft for Plain Calico Looms —Doc : TDC 29 (404).

This Standard prescribes requirements for bottom shaft for plain calico overpick cotton looms.

Members may send their comments on the above draft Standard before August 25, 1962, to Shri R. M. Patri (*M.*), Works Manager, Hyderabad Allwyn Metals Works Ltd., Sanatnagar, Hyderabad 18, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

2. Draft Indian Standard Code for Designation of Copper and Copper Alloys—Doc: SMDC 1 (326).

This Standard specifies the symbols to be used for the designation of copper and copper alloys on the basis of their chemical composition, physical conditions, etc.

Members may send their comments on the above draft Standard before September 12, 1962, to Dr. D. R. Malhotra (*M.*), Golf Course Road, Ajmer, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 14/69 Civil Lines, Kanpur; or 2/21 First Line Beach, Madras 1.

FORTHCOMING CONFERENCES

Seventh Indian Standards Convention, Calcutta, January 28 to February 2, 1963

The Seventh Indian Standards Convention will be held at Calcutta from January 28 to February 2, 1963.

The Convention will have eight technical sessions dealing with the following subjects: (i) Food purity and food quality standards; (ii) Aluminium in electrical technology; (iii) Standardization in automobile industry; (iv) Informative labelling; (v) Standardization in multipurpose projects; (vi) Export promotion and standardization; (vii) Consumers' organizations and standardization; and (viii) Promotion of company standardization in India.

Further details regarding the Convention can be had from the Organizing Secretary, Seventh Indian Standards Convention, Indian Standards Institution, Manak Bhavan, 9 Mathura Road, New Delhi 1.

Symposium on 'Relay Systems and Finite Automata', Moscow, September 24-October 2, 1962

A Symposium on 'Relay Systems and Finite Automata' will be held at Moscow under the auspices of the International Federation of Automatic Control from September 24-October 2, 1962. The following subjects are proposed to be discussed at the Symposium:

1. Problems of language for description of the operation of the relay device with suitable algorithm for deriving a flow table;
2. Problem of assignment, taking into account the hazards;
3. Problems of minimization of the structure of relay devices, *viz.*, (i) algorithm for the minimization of 'factored' Boolean expressions,

(ii) algorithms for constructing 'bridge' (non-series parallel) contact networks, and (iii) approximate methods of minimization ;

4. Problems of machinization of the synthesis and analysis of relay devices ;
5. Problems of reliability of relay devices ;
6. Relay devices, finite automata, logical nets, conjunction, difference, possibilities of unification of these concepts ;
7. Various optimization criteria for relay devices ;
8. Methods of synthesis of the structure of ordered relay systems ; and
9. Methods of synthesis of structures with pulsed elements.

Further details regarding the Symposium can be had from Prof. Gavrilov, Institut avtomatiki i telemechaniki, Kalanchevskaja ul. 15 a, Moscow I-53, U.S.S.R.

Symposium on 'Electron Devices', Pilani, December 1962

A Symposium on 'Electron Devices' will be held in Pilani in December 1962, under the auspices of the Central Electronics Engineering Research Institute, Pilani. The aim of the Symposium is to bring together interested workers in research organizations, institutions of higher learning, and industry to enable them to exchange ideas and discuss mutual problems.

The scope of the Symposium will include modern techniques and the latest types of electron devices. Tentatively, the titles and scopes of the sessions are intended to deal with (i) vacuum tubes, (ii) solid state devices, (iii) novel devices, and (iv) techniques and processes.

Members desirous of contributing papers to the Symposium should send the abstract of the paper, not exceeding 250 words so as to reach the Central Electronics Engineering Research Institute, Pilani, on or before August 31, 1962.

Further details regarding the Symposium can be had from the Assistant Director, Central Electronics Engineering Research Institute, Pilani, Rajasthan.

BOOK ACKNOWLEDGMENTS

1. **Elements of Bridge Engineering.** R. A. Agrawal. *Saroj Prakashan*, Allahabad, Rs. 7.50. 271 pages.

This book intended to serve as a text-book in the subject of 'bridge engineering' for students of engineering diploma classes, deals with description, fundamentals of design and construction of permanent and temporary bridges, and foundations and ancillary structures such as piers, abutments and wingwalls. A chapter giving fundamentals of river raining is also included.

2. **Engineering Materials.** J. Chandra. *Saroj Prakashan*, Allahabad, Rs. 6.25. 288 pages.

This book dealing with the basic properties, elements of manufacture and important uses of engineering materials is intended to cater for the requirements of students of engineering diploma and certificate courses in the subject of engineering materials.

3. **Introduction to Structural Stability Theory.** Gerard. *McGraw-Hill Book Co. Inc.*, $ 7.95. 170 pages.

This book intended to serve as an introductory text-book on stability theory and its application to the design and analysis of lightweight structures, deals with the fundamental physical and mathematical aspects of the stability theory in three parts. Part 1 deals with the physical and mathematical bases of stability of flat elements; Part 2 treats the design aspects of plate structures subject to instability; and Part 3 presents elastic and inelastic stability of cylindrical shells.

4. **Overseer's Duties and Accounts.** B. S. Goyal and J. Chandra. *Saroj Prakashan*, Allahabad. Rs. 7.50. 288 pages.

This book, intended to serve as a text-book in the subject of 'overseer's duties and accounts' as prescribed for the National Certificate Course of the All-India Council for Technical Education, deals with the responsibilities and obligations of an overseer working in Government departments.

5. **A Text-book on Estimating, Costing (Civil) and Civil Drawings.** D. D. Kohli. *Ramesh Publications*, Ambala. Rs. 10.00. 2nd edition. 212 pages.

This second edition of a book, intended to serve as a text-book for students of civil engineering diploma and draftsman classes, has been revised to include more drawings and examples of estimating, analysis of rates, and tables of metric standards.

6. **Building Materials for B.E., L.C.E., L.M.E., L.E.E. (First Year).** Krishnaswami. *Prabha Publications*, Madras, Rs. 3.75, 2nd edition. 175 pages.

This second edition of a book intended to serve as a text-book for first year students of engineering degree courses and Technical Board Examinations of the State Governments, has been revised to include more information and data on building materials commonly used in India.

7. **Applied Mechanics for L.C.E., L.M.E., L.E.E. (First Year).** Krishnaswami. *Prabha Publications*, Madras, Rs. 4.50, 2nd edition. 204 pages.

This second edition of a book, dealing with principles of applied mechanics and intended to serve as a text-book for students of first year engineering degree courses and Technical Board of Examinations, has been revised and enlarged to increase its scope.

8. **Elementary Reinforced Concrete Design.** W. Morgan. *B. I. Publications*, Bombay, Rs. 16.00, 2nd edition. 408 pages.

This second edition of a book intended to serve as a text-book in reinforced concrete design is based upon the British Standard Code of Practice: CP114 (1957)—'The Structural Use of Concrete in Buildings'. It covers general structural mechanics, design of reinforced concrete slabs, beams, columns, footings and hollow tile floors.

9. **Polytechnic R.C.C.** N. R. R. Rao. *Saroj Prakashan*, Allahabad. Rs. 7.50. 272 pages.

This book is intended to serve as a text-book in reinforced cement concrete for students of engineering diploma classes, deals with theory of reinforced cement concrete, concrete technology and practical design of simple reinforced concrete structures. It also includes a chapter covering basic principles of prestressed concrete and shell roof construction.

10. **Geometrical and Machine Drawing.** N. D. Bhatt. *Charotar Book Stall*, Anand, Rs. 12.50. 135 pages.

This book is intended to serve as a text-book in geometrical drawing and machine drawing for students of engineering diploma courses. It deals with the construction of simple geometrical figures, curves, scales, loci of points, and principles of orthographic projection and their application to the drawing of simple machine parts. Chapters on free-hand sketching, dimensioning and isometric projection are also included.

11. **Thermodynamics for Engineers.** S. C. Bhattacharyya. *Basu, Mallik & Co.*, Calcutta, Rs. 11.75, 4th edition. 648 pages.

This fourth edition of a book dealing with the principles of thermodynamics and their application to engineering practice has been revised with a view to meet the requirements of the present standard of engineering degree courses.

12. **Workshop Management (Organization and Foremanship).** Y. S. Joshi. *Saroj Prakashan*, Allahabad. Rs. 6.25. 234 pages.

This book deals with the basic principles of workshop management with regard to layout, production planning, work study, safety, stores, purchasing, maintenance, welfare amenities, wages and incentives. Separate chapters on costing and factory laws are also included.

13. **Square Loop Ferrite Circuitory: Storage and Logic Techniques.** C. J. Quartly. *Iliffe Book Ltd.*, 42s. 166 pages.

This book deals with the principles of operation of coincident drive stores and systems for increasing the speed of operation, and gives brief descriptions of the properties and application of square loop ferrite cores in computers and other digital equipment.

14. **Television Receiver Servicing, vol. 2: Receiver and Power Supply Circuits.** E. A. W. Spreadbury. *Iliffe Books Ltd.*, 35s., 2nd edition. 475 pages.

This second edition of the second volume of a book intended to serve as a guide and reference book for engineers engaged in television receiver servicing has been revised to include separate chapters on TV/FM receivers, printed circuits, and effect on service work of 625-line operation. New techniques such as press button tuning, automatic tuning, remote control and automatic contrast control have also been dealt with.

15. **General Industrial Science.** E. H. Wise. *Blackie and Son Ltd.*, 25s. 454 pages.

This book presents in brief the fundamentals of a wide range of engineering and ancillary science subjects and is intended to serve as a general guide to students in all branches of industry. It deals with industrial chemistry, heat, light and sound; mechanics of solids and liquids; instrumentation; technical electricity; chemical engineering operation and engineering materials. Chapters on fundamentals of engineering drawing and safety in industry are also included.

LIST OF NEW ELECTIONS AND TRANSFERS

(*Continued from Bulletin for May 1962*)

MEMBERS

No.	Name
2569	Bhalchandra Kashinath Garde
2570	Nirmal Chandra Sen
2571	Sachchidananda Sen
2572	Himanshu Sekhar Sinha
2573	Narasinh Narayan Godbole
2574	Paul O. Langguth
2575	Beli Ram Khera
2576	Diptendralal Mitra
2577	Kolar Venkata Seshachar
2578	Richard Russell Sarginson
2579	Doraisamypillay Ambrose
2580	Dinkar Vishwanath Ketkar
2581	Sadasivam Govindarajan
2582	Priyada Kanta Nag*
2583	Mohammed Ibrahim*
2584	Arunprasad Ghosh*
2585	S. Gopalkrishna Reddi*
2586	Shambhubhai Naranbhai Patel*
2587	Col. Sathyavijayanagaram Kuppuswami Somasundaram Mudaliar*
2588	Col. Ranjit Rai Bahl*
2589	Damodar Vaman Potdar*
2590	Meherwanji Framroze Mehta*
2591	Sriramula Ramamurthi*
2592	Shamrao Chintaman Oak*

ASSOCIATE MEMBERS

No.	Name
10075	Pramatha Nath Banerjee
10076	Mysore Subbarao Sriniveshamurthy
10077	Capt. Errapalli Anantharao Rajanna
10078	Krithiventi Venkateswara Rao
10079	Rohit Bapalal Dalal
10080	Shreedhar Balkrishna Deshpande
10081	Vishweshwar Nath Saksena
10082	Fg.-Off. Aswathanarayanarao Srinivasa Murthy
10083	Sureswar Mukherjee
10084	Naval Bomanshaw Sidhwa
10085	Mandiga Kesava Rao
10086	Jagdish Chandra Sinha
10087	Sukhamoy Majumdar
10088	Artatran Mohapatra
10089	Brahma Swarup Vaish‡
10090	Capt. Banwari Lal Kapoor
10091	Ramachandra Sadashiv Barve
10092	Chenji Padmanabharao Venkatesh
10093	Dattapuri Vishnupuri Gosavi
10094	Hari Uddhav Kulkarni
10095	Hironmoy Niyogi
10096	Bhalchandra Vinayak Petkar
10097	Mahanand Prasad Thakur
10098	Fg.-Off. Hassan Rangaswamy Seetharam
10099	Toshpal Singh Bharatkinker
10100	Rameshchandra Trikamlal Shah
10101	Devraj Amirchand Sikka
10102	Kantilal Ranchhodji Patel
10103	Ganesh Prakash Lal
10104	Kewal Krishna Lakhanpal
10105	Mulchand Chellaram Khatwani
10106	Capt. Virendra Ganesh
10107	Punnaveli Hariharaiyer Ramaswamy
10108	Dwarkadheesh Chandrabhan Agarwal
10109	Ramakrishnan Dore Swamy
10110	Lakshmi Narain Gupta
10111	Ganga Prashad Gupta
10112	Capt. Puran Singh Heet
10113	Melkote Venkatasubramanya Nageshaiah
10114	Kanwal Lal Bhanot
10115	Chimanlal Chhotalal Shah
10116	Shyamlal Ramgopal Agarwal
10117	Radhe Shyam Tiwari
10118	Bangalore Subbaiyer Raju Iyer
10119	Ganga Singh Ahluwalia†
10120	Shashikant Hiralal Desai†
10121	Garudadhwajan Bindiganavale‡

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* Transferred from Associate Member
† Transferred from Student
‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name
10122	Ramanujapuram Appachar Aprameya Iyengar‡
10123	Madan Mohan Gupta
10124	Purna Chandra Panda
10125	Harkishan Lal Dhiman†
10126	Dibyendu Madhab Gupta
10127	Madhusudan Mahadeo Gitay
10128	Shitala Prasad Tiwari
10129	Deba Brata Dutt
10130	S. Arunachala Reddy†
10131	Prabhas Chandra Mallik
10132	Narahari Bodhayana‡
10133	Gajanand Prasad Gupta
10134	Maj. Harbans Lal Kalia
10135	Sadhan Kumar Basu
10136	Appakate Bhaskaran
10137	Dharam Pal
10138	Bhalchandra Mukund Shrotri
10139	Bahubhai Nagarji Desai
10140	Keki Framji Karanjia
10141	Rattan Rustomji Sigamporia
10142	Lal Chand Arora
10143	Bal Wadudeo Samudra
10144	Parameswarapillay Sukumaran Nair
10145	Abraham Varkey†
10146	Lada Perumal Rajamanikkam
10147	Motilal Teckchand Gursahaney
10148	Francis Anthony Natividade Rodrigues‡
10149	Bimalendu Banerjee
10150	Arun Chandra Maitra
10151	Asok Kumar Basu
10152	Rasiklal Nathalal Dalal
10153	Manohar Lal Anand
10154	Ravindra Narayan Konkar
10155	Tara Charan Banerjee‡
10156	Satyajit Kumar Roy
10157	Airyur Pranatharthiharan Ramakrishnan†
10158	Indradeo Narain Sinha
10159	Ponakampalli Venkateswarulu‡
10160	Capt. Om Parkash Seth
10161	Capt. Lancelot Mascarenhas
10162	Shishir Chandra Roy
10163	Jacob Paulose Paul‡
10164	Purshottam Das
10165	Dinesh Chandra
10166	Virendra Nath Rikh
10167	K. R. Onnikrishnan Nair
10168	Narayanan Neelakantan
10169	Capt. Krishan Kumar Chitkara
10170	Flt.-Lt. Rajagopalan Sampath
10171	Sayar Mal Dugar
10172	Veeramaniiyer Ramachandra Ayyar‡
10173	Maj. Sripathi Saninjee Udupa
10174	Salil Kumar Bose
10175	Shyam Dass Vyas
10176	Capt. Jagdish Chandra
10177	Capt. Satya Prakash Goswamy
10178	Codati Ramamurthi
10179	Ciriyam Bhasker Dyuthikar
10180	Biswanath Gangopadhyay
10181	Bhanwar Lal Mathur
10182	Gopalasamudram Narayana Mani
10183	Sampat Mal Mathur
10184	Baswanthrao Patil
10185	Damodar Sakharam Shukla
10186	Flt.-Lt. Dipendra Kanta Nag
10187	Ashis Bhusan Sarkar
10188	Bal Krishan Sharma
10189	Birendra Nath Banerjee
10190	Ramampalayam Karuthiruman Sivanappan
10191	Capt. Bellur Sivaramiah Ramadas
10192	Canumalla Madhava Rao
10193	Charan Das Mathur
10194	Sadashiv Laxman Kanitkar
10195	Brahmadesam Subbiah Viswanathan
10196	Jag Mohan Singh
10197	Capt. Plakal Narayanier Sankar Narayanan
10198	Debnath Mukherjee
10199	Swaminathan Jaganathan
10200	Prafulla Chandra Shrivastava‡
10201	Maj. Chittaranjan Soni
10202	Bhairavan Rajam
10203	Akhilesh Chandra Agrawal‡
10204	Thomas Alexander
10205	Samrath Singh Baxi
10206	Kandalla Lakshmi Narasimhacharlu

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† Transferred from Student

‡ Transferred from Graduate

ASSOCIATE MEMBERS (*contd.*)

No.	Name	No.	Name
10207	Ananthanarasimhachar	10229	Radhanellore Chockalingam Natarajan
10208	Sat Prakash Gupta	10230	Capt. Manmohan Singh
10209	Flt.-Lt. Srinivasan Krishnamurthy	10231	Capt. Vasant Shripad Sapre
10210	Gandikota Mallikarjuna Rao	10232	Damodaran Sanal Kumar
10211	Chinni Thammiayya	10233	Capt. Keshao Shankar Pendse
10212	Maj. Ivo Pinto Lobo	10234	Darshan Singh Walia
10213	Narsinhbhai Kalyandas Patel	10235	Nirmal Kumar Biswas
10214	Birendranath Chakravarty	10236	Capt. Avtar Krishna
10215	Pana Lana Meiyappan	10237	Gajanan Sadashiv Somalwar
10216	Myleru Sivakumar	10238	Palangala Subbraya Shivaram
10217	Chaman Lal	10239	Padmalochan Das
10218	Prabhakar Shankarrao Shiralkar	10240	Mysore Venkatasubbarao Ramarao
10219	Viluppuram Narasimhaiyer Narasimhan	10241	Chitta Ranjan Datta Gupta
10220	Binay Bhushan Chatterjee	10242	Nirmal Kumar Chakrabarti
10221	Ramesh Shankar Ambekar	10243	Nalinkumar Jayantilal Dave
10222	Capt. Surjit Singh Bhasin	10244	Lt. Girish Chandra Bhatnagar‡
10223	Yogendra Lal Sadana†	10245	Bangalore Kondappasetty Narasimhan
10224	Lt.-Cdr. Brijendra Narain Kaul‡	10246	Raja Baboo Saksena
10225	Mohammed Jabbar Siraj Ahmed	10247	Gangadharamenon Atchutha Panicker
10226	Capt. Brij Mohan Sarin	10248	Madhusudan Tulsidas Amin‡
10227	Katragadda Radhakrishna Murty‡	10249	Pandurang Ramkrishna Bhisikar
10228	Adhikesavapillai Bhagavathi Pillai†	10250	Jugal Kishore Tiwary

GRADUATES

No.	Name	No.	Name
1476	Ragunathachar Doraswamy Rajagopal Iyengar	1489	C. Raj
1477	Viresh Ramanlal Satya	1490	T. Sankaranarayanaiyer Sahasranaman†
1478	Mahesh Ishwarlal Sheth†	1491	Kilanur Radhakrishna Balakrishnan†
1479	Madan Lal Nasa†	1492	Edal Jal Cassad†
1480	Chaman Lal Mahajan†	1493	Ullas Ranjan Hazra†
1481	Rajendra Deo Shukla	1494	Raj Kumar Singh
1482	Mojindar Narayanarao Keshava Rao†	1495	Jagdish Chander Mehta†
1483	Vedantachari Varadan†	1496	Nripendra Singh Bhal
1484	Arumughakkam Alankamony	1497	Krishna Nand Varma†
1485	Satya Narain Sharma†	1498	V. C. Janardan Rao
1486	Kandaswami Doraiswami	1499	Achintya Kumar Sur†
1487	Jagdish Sahai Joshi†	1500	Rameswamy Srinivasan†
1488	Vishwanath Somani†	1501	Aravamudhan Raman†

STUDENTS

No.	Name	No.	Name
31276	C. K. Ramachandran Nair	31278	C. Venkoba Ramachandran
31277	Devendra Prasad Sinha	31279	Ram Kumar Thakur

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† Transferred from Student

‡ Transferred from Graduate

STUDENTS (*contd.*)

No.	Name
31280	Ganapathi Narayanan
31281	Modiyil Mathai John
31282	Shiv Lal
31283	Karuturi Ammanna
31284	Bommana Krishnamurthy
31285	Yalamarty Ramakrishna Sarveswararao
31286	Tharoolal Pritamlal Satija
31287	Owen Michael Satur
31288	T. S. Sreenivasan
31289	H. Subbarami Reddi
31290	Vangara Ranga Rao
31291	K. A. Palaniswami
31292	Ratnakar Vishnu Jogdand
31293	Jhanda Ram
31294	Romesh Kumar
31295	Amrik Singh Parmar
21296	Sushil Kumar Bhatia
31297	Trilok Chand Gupta
31298	Gajender Kumar
31299	Sudhangsu Sekhar Mukherjee
31300	Parshotam Lal Sharma
31301	Kishin Ranjhomal Bakhru
31302	Sat Parkash Bhatnagar
31303	Porangel Varkey Joseph
31304	Mukund Narhar Damle
31305	Hari Prasad Chourasia
31306	Ram Yeshwant Samel
31307	Madan Pal Sharma
31308	Aloysius Gerald Fernandez
31309	Aranakkal Sankaran Gangadharan
31310	Prem Sagar Chopra
31311	Brij Mohan Ahuja
31312	Heeralal Vithaldas Nagar
31313	Gunvantraj Bapubhai Desai
13314	Gurdayal Singh
31315	Gurmukh Makhita
31316	Ramaswamy Venketachalam Rama Subramani
31317	Chinnareddy Krishnareddi Subramaniam
31318	Venkatarangam Sankaranarayanan
31319	Baldev Singh
31320	Bhisham Lal Gogia
31321	M. A. Jabbar
31322	Chitlapalle Ramana Rao
31323	Appala Venkata Ratna Prasada Rao
31324	Madhukar Ramchandra Sirsolkar
31325	Krishan Kumar Khanna
31326	Velayya Vaithilinga Subbiah
31327	Rajagopalan Chandrasekaran
31328	Harbans Lal Kamra
31329	Goverdhan Lal
31330	Mehar Chand Sharma
31331	Shrimati Malini Nivritta Bhujbal
31332	Lakshmikanthan Lakshminarayan
31333	Kallam Venkatappa Reddy
31334	M. Narayana Manalar
31335	Kurree Sambi Reddy
31336	Dhanraj Dandona
31337	Jagat Pal Datta
31338	Abraham Mathew
31339	Satinder Kumar Malhotra
31340	Madhav Shankar Kamat
31341	Gangiredla Sanjiva Rao
31342	Rabin Chandra Pattanayak
31343	Vashisth Tewari
31344	Perminder Singh
31345	Pillutla Venkata Ramana Murthy
31346	Samarendra Lochon Mitra
31347	Ravi Dutt Mudgal
31348	Dushmonto Chandro Panigrahy
31349	Dilip Kumar Halder
31350	Diwakar Hari Joshi
31351	Venkatavaradhan Ramabhadran
31352	Rabindra Nath Konar
31353	Jugal Kishore Marwaha
31354	Pramodananda Rath
31355	Vadapalli Suryanarayana
31356	Nikhilendra Chandra Datta
31357	Karunanidhi Sahu
31358	Manohar Shankarrao Hirulkar
31359	Satish Chandrakant Joshi
31360	Gururaj Dagadu Kole
31361	Gokulananda Pany
31362	Rajinder Pal Singh
31363	Avinash Chandra Verma
31364	Chandrakanta Roy Mohapatra
31365	Bishan Singh
31366	Bhimsen Sahu
31367	Tirloki Nath Agarwal
31368	Bhabani Prasad Rath
31369	Bommaraju Kondala Rao
31370	Tikaram Tukaram Barole

STUDENTS (*contd.*)

No.	Name
31371	Jai Pal Singh
31372	Meenakshisundaram Seshadri
31373	Jagjit Singh Nagi
31374	Bishnu Pada Sen
31375	Salek Chand Jagjit
31376	Gudur Rosi Reddy
31377	Gulab Jaromal Kodwaney
31378	Birhama Nand Gupta
31379	Ram Sharan Singh
31380	Narayan Bhattacharyya
31381	Pratty Subba Rao
31382	Yenna Surya Prakash
31383	Ravinder Nath Khanna
31384	Mineni Jayaprasada Rao
31385	Edurapalli Venkata Sanyasi Kamaraju
31386	Srinivasa Harigopal
31387	Jeshtha Nand
31388	Ajit Singh
31389	Palamootilvadakathil Jacob Koshy
31390	Syed Naeemuddin
31391	Samaresh Kumar Talapatra
31392	Vaidyanathan Gopalakrishnan
31393	Dev Prakash
31394	Jamini Kanta Bandyopadhyaya
31395	Inderjeet Sethi
31396	Mangu Venkateswara Rao
31397	Praturi Rajaretnam
31398	Krishnapada Das Chowdhury
31399	Vishwa Nath Tripathi
31400	Gopal Krishna Pandey
31401	Ramesh Chandra Nayak
31402	Hamendra Pratap Srivastava
31403	Navin Chandra
31404	Bismarck Joseph Heriberto Barreto
31405	Brij Pal Singh
31406	Krishan Chandra Gupta
31407	Rajendra Kumar Mathur
31408	Janki Dass Dhiman
31409	Bam Bahadur Pradhan
31410	Balbir Singh
31411	Madan Gopal Das
31412	Rattan Singh Roop
31413	Krishan Chander
31414	Sunder Dass
31415	Ratan Kumar Agrawal
31416	Chakka Veera Venkata Surya Prakasa Rao
31417	Ekambram Krishna Moorthy
31418	Nistala Kameswara Sharma
31419	Sudhansu Sekhar Hota
31420	Thumukunta Vishnumurthy
31421	Vanniaperumal Chellappapillai Neelakanta Pillai
31422	Potnuru Kasi Viswanath Patro
31423	Gautam Deva Tyagi
31424	Shankararaman Somnathan Iyer
31425	Jagdish Narain Seth
31426	Prithvi Raj Sadana
31427	Chand Krishan Sobti
31428	Dudekula Basha Sahib
31429	Lakshmi Narayan Pal
31430	Daya Nand Gauri
31431	Kalyanbrata Roy
31432	Madan Mohan Ahuja
31433	Narendra Mohan Relia
31434	Mahendra Kishore Raizada
31435	Narayan Chandra Pramanik
31436	Anil Chandra Saha
31437	Niranjan Lal Gaur
31438	Kurapet Venkata Varadaraja Setty
31439	Shripati Kala
31440	Om Prakash Oswal
31441	Ramesh Ramchandra Mulay
31442	Avinash Chandra Madan
31443	Barun Kumar Banerjee
31444	Bimal Kanti Guha
31445	M. Mubarak Husain Agha
31446	Suresh Mohan
31447	Arun Prakash Dixit
31448	Santi Ranjan Roy
31449	Jadupati Das
31450	Sahab Singh
31451	Bhagwati Prasad Saxena
31452	Suraj Prakash Nijhawan
31453	Gyanendra Singh
31454	Dhirendra Krishna
31455	Ashutosh Misra
31456	Rajendra Prasad
31457	Ramendra Shanker Mathur
31458	Beni Madhaw Dwivedi
31459	Surjeet Singh Sethi
31460	Rajinder Singh Sethi
31461	Amir Singh Lunial

STUDENTS (*contd.*)

No.	Name
31462	Tapan Kumar Mookhopadhyaya
31463	Ramapati Mukherjee
31464	Naresh Chandr Manglick
31465	Naresh Chandra Misra
31466	Ramendra Mohan Das Baksi
31467	Baniprasad Ray
31468	Lalit Mohan Agarwa
31469	Chitta Ranjan Deb
31470	Umayalpuram Sambasiva Raghuraman
31471	Madhukar Rangnath Kulkarni
31472	Jai Narain Mehrotra
31473	Priya Ranjan Mishra
31474	Somanath Nanda ,
31475	Kailash Narain Saxena
31476	Rajender Nath
31477	Sabyasachi Das
31478	Sakti Prasad Samanta
31479	Satish Chandra Gupta
31480	Ashok Kumar Verma
31481	Devraj Singh Karaulia
31482	Roop Chand Gupta
31483	Ranvir Singh
31484	Krishna Gopal Gupta
31485	Anil Kumar Dasgupta
31486	Ajit Kumar Bhattacharya
31487	Sakti Prasad Ghosh
31488	Surinder Mohan Sachdeva
31489	Lakshminaraniah Subramanya
31490	Arun Kumar Basu
31491	Lokenath Banerjee
31492	Prem Chand Dua
31493	Charu Chandra Karanjai
31494	Ram Naresh Singh Yadawa
31495	Tej Prakash Saxena
31496	Prem Shanker Gupta
31497	Ilam Chand Sahni
31498	Nidadhavolu Gajapati
31499	Narinder Kumar Kapur
31500	Vasudev Topandas Hingorani
31501	Greesh Chandra Saxena
31502	Suresh Chandra Sharma
31503	Krishna Gopal Agrawal
31504	Gopal Krishna Goel
31505	H. Shivarama Rao
31506	Om Prakash Mullick
31507	Prem Narayan Dwivedi
31508	Vishnu Kumar Agrawala
31509	Kuldip Lal Sharma
31510	Kishor Raichand Sheth
31511	Umakant Kusumwal
31512	Kulwant Singh
31513	Shiv Kumar Kalia
31514	K. Gopalakrishnan
31515	Kamleshwar Kumar
31516	Ramanatha Venkatraman
31517	Ved Mittra Mohla
31518	Kapilavayi Ranga Rao
31519	Mahesh Chandra Saxena
31520	Prem Prakash Varshneya
31521	Anjani Kumar Choudhry
31522	Rajendra Kumar Jain
31523	Ved Kumar Juneja
31524	Harish Chandra Adlakha
31525	Ram Chandra Gupta
31526	Ravindra Swaroop Saxena
31527	Ram Kumar
31528	Indu Swarup Dikshit
31529	Chandrakant Thakordas Wadia
31530	Bhawan Gordhandas Karira
31531	Dinesh Prasad Singh
31532	Kaleeleth Oomminikurup Vasudevan Nair
31533	Raj Pal Singh
31534	Ram Autar
31535	Pradyot Kumar Sarkar
31536	Amal Kumar Roy Chaudhuri
31537	Jagdamba Prasad
31538	Gajanan Krishna Gadre
31539	Surindra Kumar Sud
31540	Satya Prakash Sharma
31541	Madan Lal Dua
31542	Kulwant Singh Anand
31543	Harish Chandra Varshney
31544	Ramesh Chandra Arora
31545	Sunder Sugnomal Gurnani
31546	Sarat Chandra Padhy
31547	Narendra Kumar
31548	Rabindra Nath Banerjee
31549	Biresh Chandra Dutta
31550	Mohan Lal Devnani ,
31551	T. Narayana Mayya
31552	Prem Shanker Vaishya
31553	Mahendra Lal Luthra

STUDENTS (*contd.*)

No.	Name
31554	P. V. Sukumara Pillai
31555	Parmeshwari Dayal Srivastava
31556	Ramesh Chander Agarwal
31557	Divakar Vasudeo Pendse
31558	Chaitanya Prakash Gupta
31559	Manohar Lal Khurana
31560	Hari Narayan Gupta
31561	Norbert Peter Rodrigues
31562	Kuram Ramarathinam
31563	Maheshver Partap Saini
31564	B. Doreswamy
31565	Narasimhan Krishnamachari
31566	Prem Prakash
31567	Ramesh Chandra Srivastava
31568	Prahalad Palo
31569	Shyam Sunder Bhatia
31570	Damodar Keshav Bene
31571	Shiva Nath Singh Tyagi
31572	Ambikeshwar Baksh Singh
31573	Ramesh Chandra Dubey
31574	Sebaranjan Patjoshi
31575	Tushar Kanti Bagchi
31576	Somesh Chandra Bhattacharyya
31577	Saradindu Chatterjee
31578	Sushil Kumar Das
31579	Kamal Chandra Gupta
31580	Jagdish Kumar Marwaha
31581	Kuldip Raj Chopra
31582	Jiwatram Lockchand Khiani
31583	Nana Keshaorao Wasu
31584	Vishnu Pandurang Joshi
31585	Shatrughna Prasad Sinha
31586	Suresh Ramchandra Datar
31587	Dilipkumar Gumansinh Parmar
31588	Chandra Prakash Sharma
31589	Kolazhy Ramanathan Ananthanarayanan
31590	Hardip Singh
31591	Gervasius Paul Buddini
31592	Santosh Kumar Verma
31593	Arun Pandurang Inamdar
31594	Ashutosh Rana
31595	Jayant Vishwanath Gokhale
31596	Jagdish Singh Virdi
31597	Kotipalli Ramamurty
31598	Virendra Singh Rohatgi
31599	Ratnakar Sadashiv Karandikar
31600	Janardan Gajanan Pai Raiker
31601	Ashok Dattatraya Mokashi
31602	Jiban Chandra Bhattacherjee
31603	Lal Mani Sharma
31604	Kulwant Singh Randhawa
31605	Kalapatapu Rama Krishna Sarma
31606	Prem Nath
31607	Shashi Narayan Singh
31608	Girish Narian Singh
31609	Sunder Tarachand Gehani
31610	Raees Athar Siddiqi
31611	Ram Singh Verma
31612	Dharm Vir Gupta
31613	Rasiklal C. Parikh
31614	Mohinder Paul Bhanot
31615	Kewal Krishen Kotwal
31616	Damji Harjibhai Dhamelia
31617	Rajendra Ramanlal Shah
31618	Rajinder Kumar Gupta
31619	Durga Nath Kotha
31620	Raj Bahadur Gupta
31621	Kailash Prasad
31622	Jethabhai Rameshchandra
31623	Paul Singh Mudhar
31624	K. K. Hydrose
31625	Madan Gopal Gupta
31626	Surinder Singh
31627	Jawahir Lal
31628	Pappu Lakshmana Rao
31629	Pushkar Nath Dhar
31630	Prem Singh Tanwar
31631	Shiban Krishen Zutshi
31632	Kishen Lal Ambardar
31633	Joginder Singh Maan
31634	Tapash Guha Thakurta
31635	Parkash
31636	Khagendra Lal Dey
31637	Chatura Ram
31638	Jawahir Lal Bhan
31639	Madamala Pundarikaksha Rao
31640	Rachakonda Dattatreyulu
31641	Dwarka Dass Abrol
31642	Girdhari Lal Mattoo
31643	Pukh Raj Bora
31644	Arvind Kumar
31645	Sobhagy Mal Kothari

STUDENTS (*contd.*)

No.	Name
31646	Ram Kunwar Gupta
31647	Kanti Chandra Mathur
31648	Vishnu Swaroop
31649	Madan Mohan Agarwal
31650	Pran Nath Langar
31651	Veerindar Kumar Patwari
31652	Rajinder Lal
31653	Kailash Chandra Sharma
31654	Krishan P. Lachhwani
31655	Gandham Krishna Mohan Rao
31656	Karan Lal A. Mathur
31657	Prem Datt Parashar
31658	Gurcharan Singh Khera
31659	Chandan Singh Sindhal
31660	Janardan Swarup Tyagi
31661	Parimal Jamnadas Ashar
31662	Baldev Raj
31663	Jagdish Chander Rawla
31664	Murli Manohar Singh
31665	Anand Rochiram Raisinghani
31666	Kailash Vallabh Vyas
31667	Ravindra Kumar Verma
31668	Jai Kishan
31669	Nayani Krishnamurthi
31670	Arun Kumar Kashyap
31671	K. Ahamed Shariff
31672	Abdul Munaf
31673	Narinder Mohan Kalia
31674	Ram Krishna Kapoor
31675	Suresh Chandra Gautam
31676	Budh Mal Sardarmal Mathur
31677	Harsaran Singh Bhatia
31678	Sudarshan Kumar Qumara
31679	Chaman Lal Drabu
31680	Kadali Venkata Suryanarayana
31681	Radhe Mohan Kapur
31682	Santosh Kumar Sharma
31683	Mohar Chand Goel
31684	Brij Mohan Gupta
31685	Hiro Kalumal
31686	K. T. Venkatachalapathy
31687	Ramesh Chandra Katara
31688	Rayaprolu Venkata Prabhakara Rao
31689	Brij Nath Koul
31690	Rajendra Pratap Singh
31691	Harish Swaroop Saxena
31692	Atyam Venkatanarayana
31693	Bhooraverjhala Kabeera Sagar
31694	Bhagavati Prasad Singhania
31695	Durga Singh Thakur
31696	Sushil Chandra
31697	Jogesh Chandra
31698	Padavala Bhavanarayana
31699	Girraj Prasad Sharma
31700	Devi Singh
31701	Asit Kumar Haldar
31702	Perugu Ramanna
31703	Bishamber Singh
31704	Pala Someswara Rao
31705	Sankaran Krishna Moorthy
31706	Thallapallo Narasa Reddy
31707	Satish Kumar Chowdhari
31708	K. Moorthy
31709	Bhanu Prakash Verma
31710	Ramesh Chandra Sharma
31711	Krishnaiengar Gopalan
31712	Pratap Chandra Saxena
31713	Ashwani Kumar Bajra
31714	Pendyla Gopala Krishnamurty
31715	Gandla Swamy
31716	Madho Swaroop Saiwal
31717	Solomon David
31718	Koshy Idiculla
31719	Daya Shanker Rastogi
31720	Om Prakash Sharma
31721	Panangipalli Venkata Rao
31722	Chandrakant Dahyabhai Shah
31723	Ram Singh
31724	Vengala Sreeramulu
31725	Yadubir Thakur
31726	Shivji Ram Gurjar
31727	Dhrub Nath Singh
31728	Madhukar Dattatraya Bodas
31729	Navin Chandra Avasthi
31730	Ganesh Vishnu Joshi
31731	Yarlagadda Ramakrishna Rao
31732	Madan Gopal Dubey
31733	Yogesh Kumar
31734	S. Ramachandran Nair
31735	Hari Prakash Saxena
31736	Subhas Chander Vaid
31737	Sat Nam Bhatla

STUDENTS (*contd.*)

No.	Name
31738	Buddharaju Satyanarayana Raju
31739	Tydula Eswara Reddy
31740	Omji Lall Raina
31741	Katragadda Vishnu Prasada Rao
31742	Chellaram Lokchand Khiani
31743	Veeramachaneni Sree Krishna Prasada Rao
31744	Surendra Kumar
31745	Kamada Sayibaba
31746	Gunwantbhai Khodabhai Patel
31747	Kosuri Suryanarayana
31748	Anne Sivaji Rao
31749	Bhagavatula Venkata Gopala Krishna Sarma
31750	Sonthi Krishna Sastry
31751	Ravikoti Madan Mohan
31752	Pakalapati Satyanarayana Raju
31753	Mortha Jagannadham
31754	Surendra-Kumar Ramchandani
31755	Sheelam Bali Reddy
31756	Yerramilli Sreeramamurty
31757	Mahankali Venkata Subrahmanyam
31758	Kewal Krishan
31759	Naresh Chandra Goswami
31760	Puran Dass Bhatia
31761	Hari Krishan Bansal
31762	Shanti Sarup Ohri
31763	Khushi Ram Verma
31764	Kameshwar Prasad
31765	Kuljeet Singh Gill
31766	Jagdish Narain
31767	Kimat Lal Anand
31768	Fateh Chand Sharma
31769	P. T. Krishnan Nambissan
31770	Madathamana Krishnan Embrandiry
31771	Bhisham Pitama Shukla
31772	Ramesh Chandra Verma
31773	Pararam Idandas Gianchandani
31774	Perincheri Venugopalan
31775	Mohan Lal Tandan
31776	Hari Krishan Mendiratta
31777	Khushi Ram Gupta
31778	P. N. Sivasankaran Nair
31779	V. K. Gopinathan Nair
31780	Shantilal Dayaram Soni
31781	Om Prakash Gupta
31782	Kashiswar Debnath
31783	Gurdip Singh Grewal
31784	Pravinlal Manilal Soni
31785	Ramesh Lal Taneja
31786	Anoop Singh Gulati
31787	Chandra Prakash Gaur
31788	Ishvarbhai Keshavlal Patel
31789	Pratapchandra Surajmal Shah
31790	Sunil Kumar Saha
31791	Inderjeet Sabharwal
31792	Manmohan Krishan
31793	Issar Budhumal Gagnani
31794	Mohammad Khaliq Ahmad
31795	Walaiti Ram Madan
31796	Brahma Dev Agrawal
31797	Rajnikant Trambaklal Joshi
31798	Kizhakenathu Mathew John
31799	Charanjit Lal Sharma
31800	Gulam Husein Ismail Lalani
31801	Sadhan Chandra Bhaumik
31802	Gunvani Somnath Panchal
31803	Ishwar Tarachand Tahiliani
31804	Shivcharanlal Madanlal Khandelwa
31805	Rasiklal Keshavlal Shah
31806	Chempakasseril George Abraham
31807	Maganlal Gandalal Tank
31808	Mrinal Kanti Banerjee
31809	Radhey Shyam Chauhan
31810	Govindacharyula Rama Krishna Prasad
31811	Dharam Vir
31812	Subhash Anant Pednekar
31813	Braj Bahadur Saxena
31814	Krishan Prakash Anand
31815	Rajpal Singh Hanspal
31816	Rameshchandra Shantilal Patel
31817	Murli Vidharam Tolaney
31818	Hare Krishna Verma
31819	George Patrick Wallace
31820	Ramachandran Venkata Raman
31821	Amalendu Dev
31822	Iswar Chandra Bhattacharjee
31823	Banappala Sekharappa
31824	G. B. Murulidhar
31825	Koppa Subbabhatta Dattatry
31826	Dalasanur Venkatachaliah Ananthanarayana
31827	P. Rajashekar Holla
31828	Narendra Dutt Sharma

STUDENTS (*contd.*)

No.	Name
31829	Ramachandra Shiva Shankar
31830	Gour Chandra Saha
31831	Adam Salam
31832	Dharam Parkash Gupta
31833	Mohar Singh Verma
31834	Madhav Krishna Aggarwal
31835	Shashi Kant Ojha
31836	Tapan Kumar Dass
31837	S. Hasibul Haque
31838	Shyam Mohan Srivastava
31839	Ram Nandan Singh
31840	Ram Nandan Prasad Roy
31841	Rajeshwar Singh
31842	Rajeshwar Prasad Singh
31843	Prem Nidhi Dwivedi
31844	Pashupati Kumar Gupta
31845	Panchanan Mishra
31846	M. Ahlullah
31847	Mahadeo Prasad
31848	Harinandan Prasad Gupta
31849	Bijoy Kumar Prasad
31850	Ashwini Nandan Laha
31851	Anil Bihari Sharan
31852	P. K. Narayanan Nair
31853	Kanwar Narendra Pal Singh Tomar
31854	Balraj Kumar Trehan
31855	Ravi Prakash Talwani
31856	Manohar Vasudeo Shastri
31857	Kali Charan Misra
31858	Amar Chand Jain
31859	Shree Chand Prasad
31860	Dileep Kumar Basu
31861	Pallichadath Balasubramanian
31862	Dattatraya Gajanand Athawale
31863	V. Kunjaraghavan
31864	K. V. Rameesan
31865	George Selvaraj
31866	N. Sreedharan Pillai
31867	D. Bright Singh
31868	C. G. Devarajan Asari
31869	Hariharasubramoniaiyer Krishnamoorthy
31870	Venkatesh Somanath Amarnath
31871	M. Jamal Sabir Khan
31872	Satyal Pal
31873	Om Prakash Rastogi
31874	Balvantray Chhotalal Joshi
31875	Surinder Mohan Sehgal
31876	Pawan Sut Lal Srivastava
31877	B. G. Raja Rao
31878	Satyanarayan Nagaich
31879	Srinivasaragavan Parthasarathy
31880	Vinod Shanker Misra
31881	Sarjit Rai Saini
31882	Rameshkumar Tolaram Bakhru
31883	Brij Mohan Khanna
31884	Jatinder Kumar Malik
31885	Shamsher Bahadur Singh
31886	Bala Prashad Agrawal
31887	Dhruva Vinayakarao Vaidya
31888	Kailash Narain Saxena
31889	Jospeh Naresh
31890	Bijendra Singh
31891	Lalji Sahai Srivastava
31892	Charan Singh Varma
31893	Babu Ram
31894	Inder Mohan Verma
31895	Ashok Jain
31896	Ambadi Balachandran
31897	Sultan Singh
31898	Kartar Singh
31899	Maheshwar Singh
31900	Nazar Singh Sidhu
31901	Narendra Kumar Agarwal
31902	Jasmer Singh
31903	Vidya Swarup Sharma
31904	Arvind Nain Singh
31905	Jagdeo Prasad
31906	Krishan Swaroop Gangal
31907	Sudarshan Lal
31908	Himendra Pratap Sondhi
31909	Seenappa Nagaraj
31910	Gurjit Singh Birdi
31911	Jaswant Singh
31912	Pejavar Mohan Rao
31913	Sushil Kumar Banerji
31914	Jagdish Chandra Saxena
31915	K. P. Ravindran Nair
31916	Chander Gurmukhdas Chhugani
31917	Jai Singh Panwar
31918	Pritam Singh Arora
31919	Sampara Raghavendra Rao
31920	Kanwal Nath Vashisht

STUDENTS (*contd.*)

No.	Name
31921	Samarjit Basu
31922	Kehar Singh Jandu
31923	Shrikant Vinayak Khanwalkar
31924	Bachubhai Shankerlal Patel
31925	Ved Prakash Bali
31926	Krishna Murari Lal Srivastava
31927	Gurmukh Singh
31928	Raj Kumar Bhandari
31929	Kalyan Kumar Banerjee
31930	Chandra Bhan Bhatia
31931	Mohinder Singh Dhaliwal
31932	Pramod Kupar Gupta
31933	Satish Chander Mital
31934	Bishweshwar Sharma
31935	Gouranga Chandra Dey
31936	Man Mohan Kaila
31937	Bhoop Singh
31938	Bakul Chandra Bhattacharyya
31939	Sukumar Chandra Saha
31940	Mohan Lal Mattoo
31941	Prem Parkash Jain
31942	Anirudh Kumar Sharma
31943	H. N. Parthasarathy
31944	Shaikh Mahmood Hossain
31945	Ram Jee Singh
31946	Surinder Kumar Malhotra
31947	Balbir Singh
31948	Mohinder Singh Panesar
31949	Ajit Singh
31950	Sunder Lal Gupta
31951	Satya Pal
31952	Devinder Singh Chadha
31953	Adhir Chandra Bhadra
31954	Vishwa Nath Kapoor
31955	Uttam Chand
31956	Prabhu Dayal
31957	Om Parkash Sehgal
31958	Surinder Kumar
31959	Surjit Singh Sandhu
31960	Sanjoy Kumar Das
31961	Kewal Krishan Pahwa
31962	Brij Mohan Sharma
31963	Mulk Raj Monga
31964	Ramesh Chandulal Shah
31965	Raojibhai Vaghjibhai Patel
31966	Shib Shankar Dalal
31967	Rattan Lal Nadir
31968	Gurnam Singh Grewal
31969	Kamalakar Vinayak Khadilkar
31970	Jasbir Singh Bhalla
31971	Amar Nath Trivedi
31972	Anil Madhukar Deshpande
31973	Arjan Dev Narang
31974	Pranab Kumar Maitra
31975	Natverlal Jekisondas Mehta
31976	Kewal Krishan Puri
31977	Childatur Venkatanaranappa Gopal
31978	Prem Sagar Mehta
31979	Dev Singh Segoo
31980	K. P. Raveendran Nair
31981	Arvind Jagjivan Bhatt
31982	Kailash Chand Jain
31983	Din Dayal Jain
31984	Romesh Chand Jain
31985	Satya Bhushan Prasher
31986	Padam Sain Jain
31987	Tilak Raj Rajput
31988	Surinder Kumar
31989	Om Prakash Sachdeva
31990	Satya Paul Gambhir
31991	Suresh Chandra Jain
31992	Kishorekumar Mayashanker Joshi
31993	Brijender Krishan Palta
31994	Ghansham Sharma
31995	Navinchandra Dhirajlal Bateriwala
31996	Amir Chand Bhatia
31997	Jagdish Lal Sapra
31998	Mani Ram Gurera
31999	Sohan Singh
32000	Jawahar Lal Gupta
32001	Hardyal Singh
32002	Yash Paul Saggi
32003	Thadho Assandas Mamtani
32004	Satya Dev Gupta
32005	Mohinder Paul Goel
32006	Ramesh Kumar Bhandari
32007	Subhash Chandar Rattan
32008	Parmeshwar Prasad Shukla
32009	Shyam Narain Shukla
32010	Janak Raj Kukerja
32011	Kewal Krishan Wadhown
32012	Sohan Singh Rattan

STUDENTS (*contd.*)

No.	Name
32013	Bawa Harjit Singh
32014	Gurdev Singh
32015	Bidhu Bhusan Bhawal
32016	Bhagwan Singh Parmar
32017	Prakash Chandra
32018	Harbir Singh Panesar
32019	Amarjit Singh Grewal
32020	Saifuddin Tayebali Bharmal
32021	Madan Lal
32022	Ajitsinh Manubha Rana
32023	Kanwar Singh
32024	Bharatkumar Ramprasad Bhatt
32025	Amitabha Gangopadhyay
32026	Brij Mohan Kumar Malhotra
32027	Balwinder Sngh Bhullar
32028	Iqbal Chand Khera
32029	Prem Kumar Wadhawan
32030	Shakti Kumar
32031	Shri Narain Srivastava
32032	Jagdish Lal Kapoor
32033	Lok Paul
32034	Hari Krishen
32035	Satish Kumar Kalia
32036	Krishan Chand Singla
32037	Satya Pal Verma
32038	Gurbachan Lall
32039	Hari Mohan Dhir
32040	Balram Sagar
32041	Ramesh Chander
32042	Darshan Singh
32043	Pijush Kanti Bhattacharjee
32044	Mohinder Singh Chhina
32045	Sukhdev Raj Sharma
32046	Jainti Parshad
32047	Anand Prakash
32048	Swadesh Kumar Anand
32049	Yadukul Bhushan
32050	Ramendra Nath Bose
32051	Ajit Kumar Saha
32052	Amal Kumar Chanda
32053	Rabindra Nath Mukherjee
32054	Gollakota Lakshminarayana
32055	Biswanath Ganguly
32056	Anirudh Prasad Shrivastava
32057	Singamu Konda Reddy
32058	Bhalchandra Ajabrao Paddakhe

No.	Name
32059	Achal Saran Kapur
32060	S. Hariharan
32061	Vadapalli Krishna Perayya Sastry
32062	V. V. P. Babu Rao
32063	Purushottam Dattatray Kulkarni
32064	Sadashiv Govind Humnabadkar
32065	Duli Chand Jain
32066	E. Natarajan
32067	B. Shridhara Rao
32068	P. Purandar Rao
32069	A. T. Poovanna
32070	Sirur Suresh Rao
32071	Shashikant Somnath Fulkar
32072	P. S. Balasubramanian
32073	Indrapati Mishra
32074	Kondichetty John Jai Raj
32075	Santosh Prasad Satsangi
32076	Yekula Ramalingeswara Rao
32077	B. R. Suri
32078	Ram Nath Cheema
32079	Vasdev Thadharam Harchandani
32080	Mandalika Venkata Subba Rao
32081	Aripirala Murali Krishna Murthy
32082	Thirumala Sri Krishnamacharlu
32083	Mohan Namikram Jethra
32084	Mukhram Singh Yadava
32085	Bijan Kumar Nath
32086	Deepak De
32087	Tapan Kumar Banerjee
32088	Alihussain Abdulhussain Taquee
32089	Shree Ram Singh
32090	Jagdish Chandra
32091	Ambati Balarama Reddy
32092	Garikipati Radhakrishna
32093	Shaik Mohammed Abdul Hamid
32094	Nirmalya Prasun Chakraberty
32095	Mihir Kanti Acharyya
32096	Thayyar Madabusi Narasimhan
32097	Nirendra Nath Mukherjee
32098	Potturi Bhaskara Rao
32099	Ranjit Singh Thethi
32100	Krishna Dutt Sharma
32101	Manindra Lal Datta
32102	Amiya Kumar Guha
32103	Subhas Chandra Basu Roy
32104	Karri Krishna Reddy

STUDENTS (*contd.*)

No.	Name	No.	Name
32105	Singamsetty Syamji Prasad	32151	Gangesh Jha Gang
32106	Katta Meerasaheb	32152	Chandra Kanto Ghosh
32107	Kalidas Krishna Murthy	32153	Ganges Chandra Banerjee
32108	Krishan Kumar Sabikhi	32154	Hiran Kumar Pain
32109	Rajendra Singh Bhamraw	32155	Sakti Pada Das
32110	Mohammad Kalim	32156	Subodh Chandra Das
32111	Rachuri Madana Mohana Rao	32157	Amal Chandra Ghosh
32112	Asok Kumar Dhar	32158	Makhan Lal Patwari
32113	Bharat Singh Tomar	32159	Amlan Kumar Datta
32114	Anand Prakash Jain	32160	Sasanka Sekhar Gangopadhyay
32115	Govardhanam Suryanarayanachari	32161	Sourendra Nath Ghosh
32116	Gurjit Singh	32162	Dulal Kumar Ghosh
32117	Rajendra Kumar Agarwal	32163	Sumiti Kumar Sinha
32118	Suresh Chandra Sharma	32164	Ashim Kumar Dey
32119	Kode Basava Venkateswara Rao	32165	Samarendra Nath Ghose
32120	Anand Narasingrao Kamalapur	32166	Birendra Nath Das
32121	Rama Prasad Roy	32167	Dipti Ranjan Sen Gupta
32122	Deepak Ranjan Dash	32168	Chinmay Das Gupta
32123	Gunnepalli Banakavi Prasada Rao	32169	Braja Bihari Ray
32124	Adabala Ramachandra Rao	32170	Amitabha Basu
32125	Tarkeshwar Shukla	32171	Kalidas Dutta
32126	Sankar Prasad Manna	32172	Abhaya Kumar Singh Deo
32127	Jinka Subbarayudu	32173	Priya Ranjan Banerjee
32128	Nirmalendu Haldar	32174	Birendra Chakrabarti
32129	Prakritiswar Chatterjee	32175	Amiya Kumar Das
32130	Ajoy Kumar Mukherji	32176	Prabir Kumar Banerjee
32131	Bishnu Lahiry	32177	Shyamal Kanti Adhya
32132	Bidyapati Nag	32178	Raj Kumar Sen
32133	Supriti Kumar Ghosal	32179	Aurobindo Sen
32134	Kandikuppa Syamala Rao	32180	Prahlad Lal Jain
32135	Bhupal Chandra Chanda	32181	Sunil Kumar Nag
32136	Vuyyuri Venkata Rao	32182	Nirmal Kumar Misra
32137	Maurice Charles D'Cruz	32183	Sekharesh Chandra Bose
32138	Ajant Kumar Mukherjee	32184	Subhabrata Basu
32139	Madan Mohan Dutta	32185	Gopal Chandra Bhattacharya
32140	Phanindra Nath Guha	32186	Gian Parkash Chopra
32141	Basudeva Gupta	32187	Narayan Chandra Das
32142	Gopal Das Jalan	32188	Arvind Kumar Garg
32143	M. Subba Ramaiah	32189	Buhusu Venkateswara Rao
32144	Ajay Kumar Bhattacharya	32190	Sushanta Kumar Bhattacharya
32145	Surya Kumar Thakkar	32191	Mrinal Kanti Bhattacherjee
32146	Abu Torab Mallick	32192	Syamal Kumar Banerjee
32147	Jagat Narayan Datta	32193	Mrityunjay Gongopadhyay
32148	Sachida Nand Sinha	32194	Bijay Kumar Muhuri
32149	Sukamal Barua	32195	Nethala Solomon Raju
32150	Shilendu Mukherjee	32196	Meenakshi Suryanarayana Rao

STUDENTS (*contd.*)

No.	Name	No.	Name
32197	Gubbi Vasudeva Rao	32204	Ranendra Nath Gupta Bhaya
32198	P. K. Abraham	32205	Saumendra Nath Mukhopadhyay
32199	Sankarannair Ramachandran Nair	32206	Tarapada Hatua
32200	Parameswaranpillai Sivasankara Pillai	32207	Manohar Khushiram Keswani
32201	Subramony Venkitaramanam	32208	Anthony Canton
32202	Sakti Rajan De	32209	Jonnala Nagendra Reddy
32203	Satyendra Kumar Ghose		

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here

Shri H. S. Batlivala

Shri Homi Shapurji Batlivala, B.E., A.M.I.Struct.E., M.I.E., died on March 30, 1962, at the age of 60.

Shri Batlivala graduated in civil engineering from the Engineering College, Poona in 1926. He worked with the Hindustan Construction Co. Ltd. in the capacity of Assistant Engineer during 1927-28 and as Engineer-in-Chief during 1928-29. In 1929, he joined the Bombay Port Trust as Supervisor and was later promoted to Engineer-in-Chief, Building Construction and Repair Work. During this period, he was responsible for the design of a number of concrete and reinforced concrete buildings, bridges, roads, water towers, etc. in Bombay and Lahore. He joined the Concrete Association of India as Assistant Engineer in 1932, and was promoted to Deputy Chief Engineer in 1947. He was responsible to a large extent for the progress and growth in the activities of the Association. He was also the Associate Editor of the *Indian Concrete Journal.*

Shri Batlivala was Honorary Secretary of the Bombay Centre and its Chairman during 1949-50. He was a member of the Governing Council of the Indian Roads Congress and Vice-President of the Indian Roads Transport Development. He was also the Representative in India of the Institution of Structural Engineers, London, since 1958.

Shri Batlivala joined the Institution as Associate Member in 1936 and was transferred to Member in 1943.

Shri M. V. Mahajan

Shri M. V. Mahajan, B.E. A.M.I.E., died on January 1, 1961, at the age of 60. He was a Life Associate Member in the Institution.

Having obtained the B.E. (Civil) degree of Bombay University in 1930, he joined the Military Engineering Service as First Grade Surveyor. He later rose to Sub-Divisional Officer, Assistant Garrison Engineer, Garrison Engineer, and to the rank of Commander, Royal Indian Engineers, in 1933. After retirement in 1956, he practiced as a Consulting Engineer in Poona. During his professional career, he was responsible for construction of a number of roads and buildings of military importance.

Shri Mahajan joined the Institution as Associate Member in 1949.

Shri T. K. Mirchandani

Shri T. K. Mirchandani, B.E. A.M.I.E., died on March 15, 1962, at the age of 67. He was a Life Associate Member of the Institution.

After obtaining the Bachelor of Engineering (Civil) degree of the Bombay University in 1917, he joined the service diploma course of the Imperial Forest Research Institute and College, Dehra Dun, in 1918 and obtained the Diploma in 1919, securing distinction in forest engineering and surveying. After completion of practical training in the Kanara forests, he was appointed Extra Assistant Conservator of Forests in the Sukkur Division, Sind, in April 1921. In the year 1962, he was appointed Sub-Divisional Forest Officer in Dangs, and was later promoted to Divisional Forest Officer and then to Conservator of Forests, Dharwar. He retired from Government service in 1950.

Shri Mirchandani joined the Institution as Associate Member in 1923.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

STUDENT of the Institution of Engineers (India), age 23, passed Intermediate Science, and first class civil engineering diploma from Hewett Engineering School, Lucknow, seeks suitable post in Delhi or outside (Office ref. E.S. 106)

SUPERVISING ELECTRICAL ENGINEER, B.E.(Mech.), B.E.(Elect.), M.A.S.E.E.(London), M.I.C.E.(U.S.A.), A.M.I.E., age 30 years with 7½ years experience in project design and detailing work, installation, commissioning, maintenance and repairs of large industrial plants, electrical equipment, would be available in August 1962. Only a decent offer with a starting salary in four figures will be acceptable. Present salary is in four figures. Has been holding very responsible position in various projects works and had been constantly working in reputed foreign concerns with British, German, Japanese and American engineers and technicians. All correspondence regarding employment may kindly be made to the following address only : B. L. Ram, 49 Thakurbari Road, P.O. Sakchi, Jamshedpur 1, Bihar.

RECENTLY RETIRED CHIEF ENGINEER from the Indian Government Railways, with own house and telephone, is prepared to work as a Consultant, undertake planning and execution of projects, and represent technical and business interests in Delhi. (Office ref. E. S. 107)

ENGINEER-ADMINISTRATOR with several years experience in the fields of liasion, research in India and abroad, design and development, management, administration, organization, production and sales. Served on several technical committees of the Government, scientific and industrial bodies, as advisor on selection committees of the Public Service Commission and universities. Held important posts such as Structural and Aerodynamic Engineer, Director (Research and Development), and the office of President of a section in the Indian Science Congress. Acted as leader of a delegation for selection of electronic equipment. Author of several technical papers and reports on technical problems, pilot plants, and special instruments. Member and Fellow of various professional institutions and learned societies in India and abroad. Over 25 years of standing in the profession ; seeks suitable assignment. (Office ref. E.S. 108)

Form 303 (rev. 4)

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

November 1962 Examinations

General information and instructions to candidates

(Approved by the Examinations Committee, 51st Meeting, Resolution 21, 30th December, 1958)

(Revised by the Examinations Committee, 57th Meeting, Resolution 19, 27th-29th June, 1961 ; and 58th Meeting, Resolution 10, 13th and 14th October, 1961.

(1) The next Studentship and Associate Membership (Sections A and B) Examinations will be held from Monday, November 5, 1962 to Monday, November 12, 1962, both days inclusive. The application forms for the Associate Membership (Sections A and B) Examination and the programme of examinations are attached to this *Bulletin.*

(2) **All applications accompanied by examination fees for admission to the November 1962 examinations should reach the Head Office before 12 noon on Saturday, September 15, 1962.** Examination fees once paid are neither refundable nor transferable to a subsequent examination or to any other account. Receipt of examination forms will not be acknowledged by the Head Office, unless accompanied by a self-addressed post-card.

(3) **Examination fees should be preferably deposited at the State Bank of India in the candidates' locality. Attention of the candidates is specially drawn to item 4 in Form 304 (rev. 8) and item 5 in Form 305 (rev. 7) in this regard. The instructions for making such payment are given in card A (attached herewith) and on its reverse. Other modes of payment may be used only if this is not possible. Payment of examination fees by cheque will not be accepted.**

(4) No application for a change of examination centre will be entertained after 12 noon on Saturday September 15, 1962.

(5) Students who are in arrears of subscription will not be admitted to the examinations.

(6) **The Institution reserves the right to reject incomplete or illegible applications without any reference to the candidate.**

(7) No Student will be permitted to appear in the Section B examination unless he has fully passed the Section A examination or secured exemption therefrom. A candidate for the Section B examination should therefore mention the year in which he passed the Section A examination.

(8) Students appearing for the Section B examination under the revised rules 11.2.1 to 11.2.9 of the rules of examinations (see 'Rules and Syllabuses of Studentship and Associate Membership Examinations') should clearly state in the application form the name of the Local Centre to which they are attached.

(9) A candidate who has already passed the Section A and B examinations or is exempted therefrom will be permitted to appear in any paper or papers of Section A and/or Section B on payment of an examination fee of Rs. 30.00 per paper. The details of passing the Section A and B examinations or of exemption therefrom should be clearly stated in the examination form, with the grade of membership.

(10) The paper in 'Engineering Drawing II' is of 5½ hours' duration, with a half-hour recess between. Candidates will not, however, be permitted to leave the examination hall.

(11) Section B candidates should specially note to write down on the cover of their answer-books of the paper in 'Engineering Drawing II' the names of their particular sections, *viz.*, structural steelwork or reinforced concrete or machines or electrical or chemical plant.

(12) **Candidates are not permitted to use handbook(s) for the paper in 'Engineering Drawing II'. They may however use steel tables of the Dorman-Long type.**

(13) Candidates detected using unfair means in the examination hall will be expelled from the Institution and will not be readmitted to the Institution at any future time.

(14) Candidates reappearing in subject(s) in which they have already secured exemption(s), will have their paper(s) cancelled. The previous exemption(s) will stand.

(15) It is sometimes found that candidates do not enter their Studentship Number/Studentship Application Reference Number, Roll Number, or other necessary particulars on the answer-books. Such answer-books will be rejected and no attempt will be made to locate the candidates. Candidates should therefore take particular care to write down these particulars on the answer-books correctly.

(16) **The results of the November 1962 examinations will be declared before the last day of February 1963.**

(17) Applications for revaluation of answer-books will not be entertained.

(18) After the declaration of results, the marks of each examination will be communicated to candidates on application and on advance payment of Rs. 5.00.

(19) **The Institution reserves the right to cancel the result of any candidate without assigning reasons, in which case, the marks will not be supplied.**

(20) In any future correspondence in regard to the November 1962 examinations, candidates should always mention the Section of the Associate Membership Examination in which they appeared and their centre of examination in November 1962.

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

November 1962 Examinations

Programme

Days	S.T. 10.00 to 1.00	S.T. 2.00 to 5.00
	Studentship Examination	
Monday, November 5, 1962	English	Mathematics I
Tuesday, November 6, 1962	Mathematics II	Physics
Wednesday, November 7, 1962	Chemistry	
	Associate Membership Examination—Section A	
Monday, November 5, 1962	Mathematics I	Mathematics II
Tuesday, November 6, 1962	Applied Mechanics	Principles and Applications of Heat, Light and Sound
Wednesday, November 7, 1962	Principles and Applications of Electricity	Theory of Structures and Strength of Materials Theory of Machines Elementary Electrical Engineering Applied Chemistry Physical Chemistry and Organic or Inorganic Chemistry
	Associate Membership Examination—Section B	
Monday, November 5, 1962	Engineering Materials	Engineering Drawing I
Tuesday, November 6, 1962	Engineering Drawing II (from 10.00 a.m. to 1.00 p.m. and 1.30 p.m. to 4.00 p.m.)	
Wednesday, November 7, 1962	Theory and Design of Structures Diffusional Processes. Evaporation and Distillation Chemical Works Organization and Management	Electrical Engineering General Geology Fuels and Combustion
Thursday, November 8, 1962	Irrigation Water Supply and Sanitary Engineering Hydro-Electricity Agricultural Engineering Machine Design Mining Metallurgy Mechanics of Fluids	Thermodynamics and Heat Engines Metallurgy Transport and Storage of Materials Principles of Heat Transmission and Furnaces Soil Mechanics and Foundation Engineering
Friday, November 9, 1962	Workshop Technology Engineering Chemistry Electrical Installations Electrical Measurements Electric Traction Ultra-High Frequency Technique Including Radar and Centimeter-Waves Electro-Chemistry Industrial Stoichiometry	Building Construction Stability and Resistance of Ships Gas Engineering Principles of Mining Metrology and Machine Tools Electricity Supply Instruments and Automatic Control in Chemical Industry Chemical Works Design and Construction Size Reduction, Mixing and Separation
Saturday, November 10, 1962	Hydraulics and Hydraulic Machinery Roads Town Planning Harbours and Docks Architecture Line Communication Railways Power Generation and Distribution in Chemical Works	Electrical Machinery Geodesy Radio Communication Principles of Heat Transmission, Heat Transfer Equipment, and Refrigeration Materials and Mechanical Construction of Chemical Plants.
Monday, November 12, 1962	Industrial Engineering and Management	Refrigeration and Air-Conditioning Aeronautics

Form 362

THE INSTITUTION OF ENGINEERS (INDIA)
8 Gokhale Road, Calcutta 20

November 1962 Examinations (New Scheme)
General information and instructions to candidates

(Approved by the Examinations Committee, 51st Meeting, Resolution 21, 30th December, 1958)

(Revised by the Examinations Committee, 57th Meeting, Resolution 19, 27th-29th June, 1961, and 58th Meeting, Resolution 10, 13th and 14th October, 1961).

(1) The next Associate Membership (Sections A & B) Examinations (new scheme) will be held from Monday, November 5, 1962 to Saturday, November 17, 1962, both days inclusive. The application forms for the Associate Membership (Sections A and B) Examinations (new scheme) and the programme of examinations are attached to the Bulletin.

(2) **All applications accompanied by examination fees for admission to the November 1962 examinations should reach the Head Office before 12.00 noon on Saturday, September 15, 1962.** Examination fees once paid are neither refundable nor transferable to a subsequent examination or to any other account. Receipt of examination forms will not be acknowledged by the Head Office, unless accompanied by a self-addressed post-card.

(3) **Examination fees should be preferably deposited at the State Bank of India in the candidates' locality. Attention of the candidate is specially drawn to item 3 in Form 363 and item 5 in Form 364 in this regard. The instructions for making such payment are given in Card A (attached herewith) and on its reverse. Other modes of payment may be used only if this is not possible. Payment of examination fees by cheque will not be accepted.**

(4) No application for a change of examination centre will be entertained after 12.00 noon on Saturday, September 15, 1962.

(5) Students who are in arrears of subscription will not be admitted to the examinations.

(6) **The Institution reserves the right to reject incomplete or illegible applications without any reference to the candidate.**

(7) No Student will be permitted to appear in the Section B examination unless he has fully passed the Section A examination or secured exemption therefrom. A candidate for the Section B examination should therefore mention the year in which he passed the Section A examination.

(8) Students appearing for the Section B examination under the revised rules 11.2.1 to 11.2.9 of the rules of examinations (see 'Rules and Syllabuses of Studentship and Associate Membership Examinations') should clearly state in the application form the name of the Local Centre to which they are attached.

(9) A candidate who has already passed the Section A and B examinations or is exempted therefrom will be permitted to appear in any paper or papers of Section A and/or Section B (new scheme) on payment of an examination fee of Rs. 50.00 per paper. The details of passing the Section A and B examinations or of exemption therefrom should be clearly stated in the examination form, with the grade of membership.

(10) Candidates are not permitted to use handbook(s) for the paper in 'Design and Drawing' of Section B. They may however use steel tables of the Dorman Long type.

(11) Candidates detected using unfair means in the examination hall will be expelled from the Institution and will not be readmitted to the Institution at any future time.

(12) It is sometimes found that candidates do not enter their Studentship Number, Roll Number, or other necessary particulars on the answer-books. Such answer-books will be rejected and no attempt will be made to locate the candidates. Candidates should therefore take particular care to write down these particulars on the answer-books correctly.

(13) The results of the November 1962 examinations (new scheme) will be declared before the last day of February 1963.

(14) Application for revaluation of answer-books will not be entertained.

(15) **After the declaration of results, the marks of each examination will be communicated to candidates on application and on advance payment of Rs. 5.00.**

(16) The Institution reserves the right to cancel the result of any candidate without assigning reasons, in which case, the marks will not be supplied.

(17) In any future correspondence in regard to the November 1962 examinations (new scheme) candidates should always mention the Section of the Associate Membership Examination in which they appeared and their centre of examination in November 1962.

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

November 1962 Examinations (New Scheme)

Programme

Days	S.T. 10.00 to 1.00	S.T. 2.00 to 5.00
Associate Membership Examination—Section A		
Monday, November 5, 1962	Mathematics I	Mathematics II
Tuesday, November 6, 1962	Applied Mechanics	Principles and Applications of Electricity
Wednesday, November 7, 1962	Heat, Light and Sound	Engineering Drawing
Thursday, November 8, 1962	Strength of Materials	Elementary Surveying
Associate Membership Examination—Section B		
Monday, November 5, 1962	Materials and Construction Mechanical Engineering Materials Electrical Engineering Materials Chemical Engineering Materials Principles and Practice of Coal Mining Mineral Dressing Electronics and Telecommunication Materials	Theory and Design of Structures Industrial Organisation and Management Theory and Performance of Electric Machines Industrial Stoichiometry and Mechanics of Fluids Principles and Practice of Metal Mining Physical Metallurgy and Physical and Mechanical Testing of Metals General Electrical Engineering
Tuesday, November 6, 1962	Structural Engineering Hydraulics and Hydraulic Machinery Generation, Transmission and Distribution of Electric Power Diffusional Processes, Evaporation and Distillation Mine Ventilation, Explosions, Fire and Inundation Refractories Applied Electronics and Circuits	Surveying and Geodesy Theory of Machines Electric Traction Fuels and Combustion Mine Surveying Foundry Engineering Transmission Lines and Networks
Wednesday, November 7, 1962	Hydraulics Industrial Engineering Illumination Engineering Elementary Electrical Engineering Mineral Dressing Practice Metallurgical Analysis Advanced Radio and Electronic Engineering	Irrigation Engineering Refrigeration Line Communication Gas Engineering Mining Geology Industrial Metallurgy Antenna and Wave Propagation
Thursday, November 8, 1962	Civil Engineering Design and Drawing Mechanical Engineering Design and Drawing Electrical Engineering Design and Drawing Chemical Engineering Design and Drawing Electronics and Telecommunication Design and Drawing	(From 10 a.m. to 1 p.m. and 1.30 p.m. to 4 p.m.)
	Mining Machinery Physics of Metals	Generation, Distribution and Utilisation of Power in Mines Metallurgy of Less Common Metals

Programme (*Contd.*)

Friday,	November 9, 1962	Architecture Air-Conditioning Radio Communication Materials and Mechanical Construction of Chemical Plants Mine Design and Planning Metallurgical Thermodynamics Radio Communication Systems	Soil Mechanics and Foundation Engineering Aerodynamics Hydro Power Engineering Metallurgy Mine Organisation and Management Engineering Metallurgy Audio Frequency Engineering
Saturday,	November 10, 1962	Public Health Engineering Railway Locomotives and Rolling Stock General Electronics Refrigeration and Air-Conditioning Mine Economics Electrometallurgy and Hydrometallurgy Electronic Measurements	Town Planning Automobile Engineering High Frequency Currents Chemical Works Organisation and Management Metallurgy and Assaying Fuels and Furnaces Industrial Electronics
Monday,	November 12, 1962	Highway Engineering Fuels and Refractories Radar Engineering and Microwave Techniques Workshop Technology	Harbours and Dock Drilling Engineering Television Utilisation of Electric Power Principles of Heat Transmission and Furnaces
Tuesday,	November 13, 1962	Thermodynamics and Heat Engines Size Reduction, Mixing and Separation Telegraphy and Telephony	Agricultural Engineering Thermodynamics Carrier Current Engineering
Wednesday,	November 14, 1962	Metallurgy of Iron and Steel Industrial Administration	Geology Production Technology Non-ferrous Metallurgy
Thursday,	November 15, 1962	Railways General Mechanical Engineering	Water Power Engineering Electrical Measurements Heat Treatment of Metals and Alloys
Friday,	November 16, 1962	Thermal Power Engineering Servomechanisms	Production Technology and Industrial Engineering Principles of Semiconductors and Transistor Circuits
Saturday,	November 17, 1962	Principles of Line and Radio Communication	

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THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. SESHADRI, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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A TECHNOLOGICAL CLIMATE WILL LEAD TO MUCH NEEDED SPECIALIZATION

B. Seshadri
Member

One of the most important things that deserve the attention of those in authority is the need to create a technological climate in the country, at a time when it is passing through what may even be the most vital phase of its development in its long history. Technology has brought untold benefits to the world, and there is no doubt that it offers by far the surest and safest way to improve the backward lot of the majority of our countrymen.

It has been said that a society that does not believe in technology is not likely to survive. This is a solemn thought, and this belief can be fostered amongst the general public by those who have direct contact with the public mind. As technology is not political activity but aimed solely at human betterment, by the control and exploitation of natural resources, it deserves the unstinted support of the Government.

Those in office should realize that the influence of the technologist is stabilizing. It makes change possible without violence, and it does not assume an attitude of complacency. The very fact that change is made possible by orderly means, which is at the same time exciting in a wholesome way, ensures stability. Perhaps, more than any other line of human activity, technology provides an outlet for vigorous and imaginative activity. It tends to suggest that there is a cure for every evil—disease, famine, floods, or any other.

It is because technology is so valuable for the country's future that every possible effort should be made to create the right technological climate in the country. Available aids to create this climate should not be held back over-strictly where they concern the establishment of a place for technological learning, or the planning and execution of an important project, or the dissemination of technological information, or an opportunity to learn latest techniques abroad. Money spent on any of these will pay enormous dividends in the not distant future, in the increased prosperity of our countrymen, and in their superior physical and mental health.

The right technological climate will then provide the backdrop against which much-needed specialization in the various capillarized channels of technology will grow and flourish. Without specialization, there will be no progress in this era of awesome achievements.

But, at the same time, in our enthusiasm, we should not forget that a first-hand and general practical knowledge of the forces of nature is what a technologist fundamentally needs. In the industrially advanced countries, it is generally accepted that even before or during academic studies elementary practical knowledge is desirable. It is certainly useful if a young man who has followed a technological course gets adequate opportunity of contact with practical life. Side by side with the acquisition of practical knowledge, a knowledge of theory should be acquired. It is not important that the young technologist knows a little about everything, but it is important that he knows and understands the fundamentals. The university should provide all that industry cannot provide later, whereas what industry can offer should not be handled by the university.

I am not unaware of the human side. Whatever kind of specialist the young man finally turns out to be, his training at the university and after underlines the technical side of his education only. It is equally important that every one of them leaving the university has a good knowledge of the humanities, and realizes that while technical work is very important in our country today, it should not be the only measure of a man.

Specialization may follow if the above conditions are met. That the need for specialization has become increasingly apparent in recent years cannot be disputed. Achievements of far-reaching consequence are the prerogative of the specialist. Such achievements in increasing numbers are needed to solve the world's—and India's—problems today.

EFFECT OF DEFECTIVE BEARING AREA IN COMPRESSION TEST OF CONCRETE

Kamaleah Ray

Associate Member

The effect of capping of a test specimen on the indicated strength of concrete has been considered by many concrete technologists. Impression goes round that the smaller bearing area (*e.g.*, due to faulty or chipped capping) indicates lower strength proportionately.

Minor defect (usually, by chipping) in cement capping is not uncommon. This defect is often taken as very serious, and construction men point out this to explain the low strength obtained by the quality control laboratory. Sulphur and other compounds have been developed for capping test specimens.

The loss of bearing area due to chipping, if it occurs, is usually low (1-2% of the surface), and the loss in the apparent strength is still lower. It will be appreciated from the experiments described below that minor chipping has very little effect on test results.

A series of tests were performed to study the variation of indicated strength with the variation of the loading area on 6 in. diameter × 12 in. long standard concrete test cylinders. The cylinders made out of the same mix and cured for equal age were subject to compression tests by centrally interposing $\frac{1}{2}$ in. thick steel discs of 5 in., 4 in., 3 in. or 2 in. diameter at the top of the cylinders. The bearing areas were thus reduced measurably. The crushing load was divided by the area of the full 6 in. face (28.26 sq. in.) to obtain the apparent strength in lb. per sq. in. The apparent strength is expressed as a percentage of the strength obtained by full face loading in the usual testing procedure. The results are given in Table 1.

Table 1

Relative strength by sub-area loading test on 6 in. diameter × 12 in. cylinders

Loading diameter, in.	Relative bearing area,%	Apparent strength,%
6	100	100
5	69	89
4	44	78
3	25	67
2	11	56

Two curves are drawn to show the apparent strengths against the loading area (Fig. 1) and the apparent strength against the loading diameter (Fig. 2). The latter curve (strength *vs.* loading diameter) indicates a fairly proportionate trend of the apparent strength with decreasing diameter of loading.

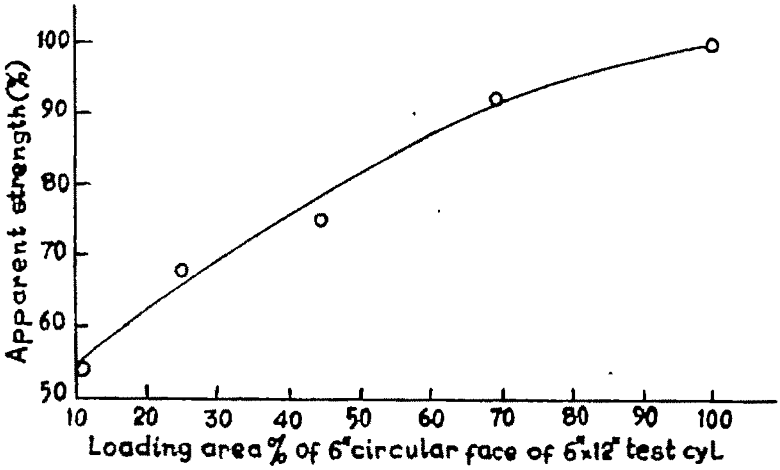

Fig. 1

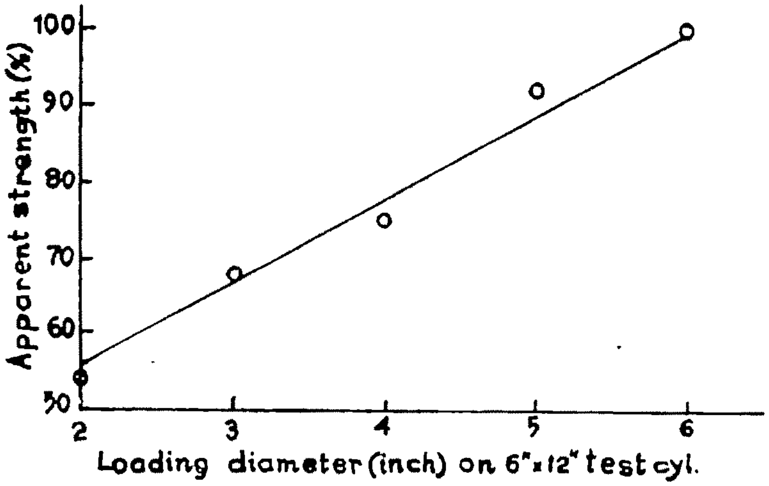

Fig. 2

This means that the apparent strength decreases at a slower rate than the rate of decrease of the loading area. For instance, while the loading area was reduced by nearly 30%, the apparent strength was lowered by about 10% only. Thus, a small amount of chipping of the cap will not alter the test result to an appreciable extent.

Another feature is also interesting to note. The maximum stress increases under the smaller area of loading, although the apparent crushing strength decreases. The maximum bearing stress is obtained by the maximum load sustained divided by the bearing area.

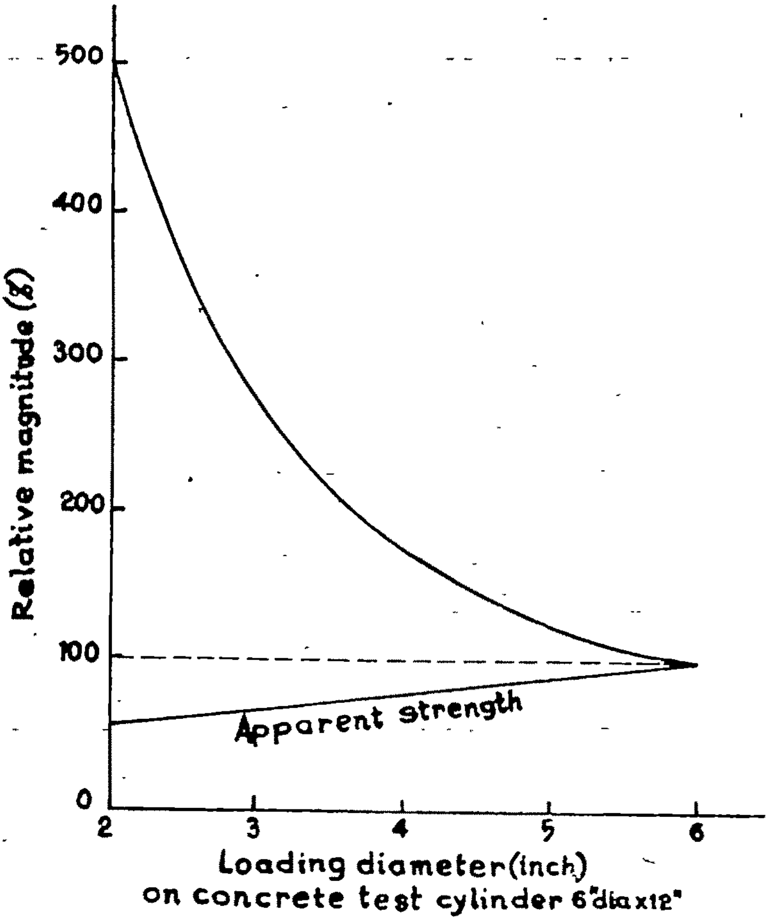

Fig. 3

Let us assume that the strength of the concrete cylinder is 2,000 lb. per sq. in. when tested under full face loading in the usual manner. The total load is, therefore, 2,000 × 28.26 = 56,520 lb. When tested through a 4 in. disc, the apparent strength drops to 78%, *i.e.*, the total (crushing) load is 44,090 lb., with an apparent strength of 1,560 lb. per sq. in. The maximum compressive stress under the 4 in. disc (12.56 sq. in.) would then be $\frac{44,090}{12.56} = 3,500$. This figure is nothing but the apparent strength multiplied by the ratio of the full-to-loading areas.

Table 2 compares the apparent strength and the maximum stress in terms of the tested strength value taken as 100%.

Table 2

Apparent strength and maximum stress in sub-area loading test

Loading diameter, in.	Apparent strength,%	Maximum stress,%
6	100	100
5	89	128
4	78	175
3	67	268
2	56	504

It will appear more significant if the strength values in Table 2 is re-written in terms of lb. per sq. in. This is done in Table 3 for concrete having a strength of 2,000 lb. per sq. in. under the usual testing procedure.

Table 3

Apparent strength and maximum stress for a 2,000 lb. per sq. in. test cylinder

Loading diameter, in.	Apparent strength, lb. per sq. in.	Maximum stress, lb. per sq. in.
6	2,000	2,000
5	1,780	2,560
4	1,560	3,500
3	1,340	5,360
2	1,120	10,080

It can be said, therefore, that when stress concentration occurs in a large block of concrete the stress may be allowed to exceed beyond that warranted by the tested strength of the concrete.

ECONOMY BY WASTE UTILIZATION

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Introduction

The fast pace of industrial development taking place all over the world has resulted in increasing quantity and variety of industrial and other wastes. This is particularly true in the case of the steel industry and plants utilizing coal as fuel, where the alarming rate of increase of waste materials (slag in the former and ash in the latter) has forced attention of research workers towards finding out new ways and means for their economic utilization. A review of the results of such investigations for the commonly occurring wastes and some suggestions for achieving economy in industry and construction work through the use of these wastes are outlined in the following paragraphs.

In general, wastes can be classified into four major categories :

1. Metallic wastes and scrap ;
2. Non-metallic industrial wastes ;
3. Sewage and domestic refuse ; and
4. Radioactive wastes.

1. Metallic wastes and scrap

Waste or scrap is an essential part of practically every manufacturing process, though the quantity varies depending on the industry and the type of manufacturing process employed. This waste or scrap may be re-used, recovered, or thrown away depending on the requirements of the particular industry and the facilities available for recycling of the scrap, if required. It may also happen that the waste products of one industry are suitable as raw material for another industry in the vicinity. Such cases are, however, very few. One such example is steel industry where a considerable portion of the feed material comprises scrap.

There are two main aspects of the utilization of wastes or scrap : (i) economy of the process, and (ii) practical difficulties involved in the handling and processing of the waste.

The economic consideration of waste utilization governs the choice of whether the waste or scrap is to be re-used, processed and re-used, or simply dumped. In general, if it contains expensive materials, these are recovered within the factory as a part of the manufacturing process and present no special problem. It is the scrap or waste of marginal value which demands careful investigation before any process for their re-use is contemplated. In this case, it must be ensured that if the scrap needs processing before re-use, the expenditure involved in processing does not make it uneconomical as compared with the use of fresh materials. There are, however, a number of considerations which may overrule the economy of the process of re-utilization. One such factor is the problem of space for dumping the waste or scrap if the rate of production of scrap and/or waste is very high. In such a case, scrap of even below marginal value has to be sorted out and re-used to avoid its piling up and occupying large areas of land, even if the cost of reclaiming and refining is much in excess of the cost of basic materials. Another factor which contributes to the adoption of uneconomic waste utilization processes is the environmental and market conditions. For example, in times of shortage of a particular material such as steel during war time, it may be desirable to reclaim such material from wastes of marginal value or below marginal values. However, in prosperous times, these stand poor chance against new and technically superior materials. Besides, there are many more variable factors in processing technology, and their combined effect makes it exceedingly difficult to indicate any clear-cut economic solution to the problem.

The second major factor, the practical difficulties of handling and processing of wastes, which must be given due consideration to make a scrap reutilization process useful and economic, can be further subdivided into (i) handling and transportation, which may require the use of mobile cranes, grabs, magnets, etc., or simple sorting to separate the undesirable components if the scrap is to be reused at the same place; and (ii) preparation of scrap to make it conform to the needs of the likely consumers. If the scrap is to be supplied to another consumer, it has to be prepared to his specifications which may vary between wide limits with regard to size, thickness, bulk and composition. For example, if a consumer wants to use a particular scrap for remelting, his requirements will call for a dense scrap to enable him to introduce maximum charge into the furnace in the shortest possible time. The scrap which may contain materials of various sizes and composition such as lathe turnings, sheets, pipes, steel plates, etc., will have to be cut to different sizes. This requires use of shears of sizes depending on the bulk of the scrap. If the scrap is bulky and massive, it is more economical to use oxygen, acetylene or other gases for cutting it to reduce the size and bulk. Heavy cast iron scraps such as flywheels and machine beds can be broken by dropping a heavy steel ball on them from a certain height. To make the scrap dense, hydraulically operated presses may have to be used, their capacity depending on the type of scrap and the requirements of the consumer. A complication which may arise at this stage is that if the scrap is to be used for charging into an open hearth furnace, the galvanized, tinned or enamelled materials, will have to be sorted out. These coatings have a deletereous effect on the production of steel by the open hearth process, and add to the overall cost of the scrap reutilization process. This extra process is not called for if the scrap is to be used for firing into a blast furnace.

An abundantly occurring scrap is lathe turnings or 'swarf' which is produced in practically every machine shop. This can be remelted provided precaution is taken to keep them clean of oil, dirt and non-ferrous metals which make them unsuitable for melting. Cleaning can be carried out by using centrifugal extractors and special washing machines. The cleaned swarf can be reduced to smaller pieces, if required, with the help of swarf crushing or chip breaking machinery.

Whatever be the scrap utilization process, the significance of separating alloy scrap from other scrap should always be borne in mind if the scrap is to be used for remelting. This is important for two reasons. Firstly, the presence of alloy scrap has a harmful effect on the production of mild steel. Secondly, since most of the alloys are imported, efforts to conserve the alloys which will otherwise go to waste in the form of scrap will add to national economy. The identification of alloy scrap in a heap of metallic scrap can be easily carried out by making a few simple observations. For example, even a little experience will tell that structural steel is generally free from alloys, while materials used for highly stressed parts are generally alloys. Besides, a number of simple and quick spot tests are also available which will indicate the presence of an alloying element.

The above considerations apply mainly to iron and steel scrap which does not present any serious problem because it lends itself easily to remelting. Hence, sale market for such scrap is also easy to find. There are certain types of metallic scrap, however, which defy any economic re-utilization process with a result that there are few consumers for such scrap. The most important amongst these are refractory metal scraps such as molybdenum, titanium, tungston, etc. In such cases, the only alternative is to develop metal working techniques to reduce the production of scrap to the minimum.

Another type of scrap which is produced in large quantities in every country having steel plants is blast furnace slag. Every ton of iron produced means a production of ¾ to 1 ton of slag. In India, about 300,000 tons of blast furnace slag is produced every year, and the figure is likely to increase to 500,000 tons at the end of the Third Plan. Any process to utilize this very large quantity of slag in a renumerative manner will add to national economy. A great deal of research and investigation has, therefore, been carried out in India and abroad for its economic utilization. The results indicate that blast furnace slag offers scope for utilization in four major ways : (i) for the manufacture of cement, (ii) as lightweight aggregate for concrete, (iii) as course aggregate for concrete, (iv) as insulating material, and (v) as medium for percolating filters.

(i) *Blast furnace slag for manufacture of cement*

Using blast furnace slag, cement was first manufactured on a large scale in Germany in 1892. Since then, it has been extensively used in concrete and reinforced concrete works in the major steel producing countries of the world in view of its constructional advantage as well as the resulting saving in the cost of cement.

The advantages of cement manufactured by using granulated blast furnace slag (produced by discharging molten slag into pools of water) over ordinary Portland cement are its higher resistance to corrosion by water and lower heat evolution. Though the blast furnace slag cement takes a longer time to attain full strength, the maximum strength is of the same magnitude as that of the Portland cement. Besides, the manufacture of blast furnace slag cement provides a useful means of utilizing large quantities of slag which is available at a low cost. Consideration should therefore be given to setting up of slag cement manufacturing plants in the vicinity of the steel plants. It may be mentioned here that one such plant is proposed to be set up at Chaibasa in Bihar to utilize the slag produced at the Tata Iron & Steel Co., Ltd., Jamshedpur, and granulated in a quenching plant. Similar plants in the vicinity of other steel plants will add to economy of the cement manufacturing process, resulting in lower cost of cement.

The slag can also be used to manufacture another important type of cement, the slag-sulphate or supersulphate cement. However, this requires slag containing a minimum of 12% alumina. The suitability of slags obtained from various steel plants in the country for the manufacture of supersulphated cement should, therefore, be investigated.

(ii) *Blast furnace slag cement as lightweight aggregate for concrete*

Foamed blast furnace slag (produced by directing a jet of water to the molten slag as it is discharged) can be conveniently and economically used as lightweight aggregate for concrete. The processing equipment for converting raw slag into foamed slag is simple and cheap. However, more research is desirable to estimate the suitability of slag as lightweight concrete. The advantages of lightweight concrete over plain concrete are indicated later in this paper.

(iii) *Blast furance slag as coarse aggregate for concrete*

Air cooled blast furnace slag, which is the most common type of blast furnace slag, can be utilized for tar macadam or coarse aggregate for concrete and is generally used as such for road construction in the U.S.A. and a number of European countries. The slag, however, requires to be crushed and screened to proper size. The workability, strength and expansion of concrete using this aggregate are comparable to the concrete using gravel or sand mixes.[5] It has the added advantage that when used as a base material for road construction, its properties are likely to improve with age.

The particle shape and cleanness of the slag recommend its use as an aggregate for surface dressing of roads. In this case, it is less sensitive to slight variations in binder distribution and is resistant to changes in application techniques.

(iv) *Blast furnace slag as insulating material*

Blast furnace slag can also be used as an insulating material in the form of slag wool. In this form, it is highly fire-resistant and can serve as suitable aggregate for fire-resistant concrete. It can also be used as a filling material to reduce transmission of heat and sound.

(v) *Blast furnace slag as medium for percolating filter*

Percolating filter demands a large surface area over which the effluent can percolate and enable bacteria and fungi to operate. The properties of blast furnace slag which recommend its use as a filtering medium in such a filter are its : (i) pitted and rough surface texture, (ii) vesicular nature, and (iii) freedom from flaky particles which provide maximum controllable voids and thus ensure free flow.

From the various possible uses of blast furnace slag mentioned so far, it can easily be inferred that economic utilization of this slag is no longer a difficult problem, provided suitable plant and equipment is made available for processing the slag to suit the requirements. An example can be cited of the steel company in Wales, Port Talbot, Glamorgan, England, where the alarming rate of production of slag resulted in encroachment of the Port Talbot harbour by slag dumps. A slag processing plant has, therefore, been set up for crushing and grading about 110 tons of slag per hr., to produce good quality aggregate for various uses.

2. Non-metallic wastes

Ash

Ash is another waste which is produced in very large quantity and yet has been put to little economic use till recently. The problem of utilization or disposal of ash is more acute in India where the use of coal as a source of heat is widespread and includes even the domestic furnaces. The biggest producers of ash are, however, thermal power plants using crude coal or pulverized coal as fuel. The increasing use of pulverized fuel in thermal power plants has aggravated the problem by producing millions of tons of ash in the form of fine dust, called 'fly ash'. At present, there are only five pulverized fuel fired thermal power plants in India, at Bokaro, Kanpur, Madras, Bombay and Trombay. However, it is proposed to add about 15 new thermal stations using pulverized fuel. This will boost up the quantity of fly ash produced to such an extent that serious thought will have to be given to its utilization elsewhere to avoid its occupying huge areas of land and representing a charge on the power produced. Fly ash is being extensively used in the U.K. and the U.S.A., as a building material. The important fields of utilization of fly ash include its use: (i) as an additive to cement, (ii) in lightweight concrete, and (iii) for land reclamation.

(i) *Use of fly ash as an additive to cement*

As an additive to cement, fly ash offers scope for its use in (i) dam construction, (ii) construction of highways, and (iii) for mass-concrete structures as partial substitute for cement. The inherent advantage of fly ash for these uses is that although it is not cement in itself, it has pozzolanic properties, *i.e.*, it combines with alkalis such as hydrated lime to form a cementitious compound. It improves plasticity and cohesiveness of cement, thus enabling easier placing and finishing. A beginning has been made in India also in this direction. Investigations carried out at the Rihand Research Laboratory, Uttar Pradesh, to evaluate the suitability of fly ash from the Bokaro thermal power station as pozzolan in cement revealed that it improved the workability and watertightness considerably. Based on the results of the investigation, the use of Bokaro fly ash for Rihand Dam was recommended. About 13,000 tons of fly ash was used in the placement of about 60 million c.ft. of concrete for the dam, resulting in a saving of about Rs. 6.8 lakhs[4].

In addition to its use for blending with cement, fly ash can also help to solve the present shortage of cement in India, caused by the rapid industrialization and construction of large development projects, by partial replacement of cement with fly ash for the manufacture of pozzolan cement. This will raise the output of usable cement although the actual production of Portland cement remains constant.[3]

Investigations carried out at the Central Building Research Institute, Roorkee, have indicated that concrete prepared with crushed sintered fly ash does not contain deleterious materials such as are generally present in clinker, breeze and raw fly ash; the presence of more than specified quantities of which are likely to cause early failure of concrete. Much, however, remains to be done in developing the methods of sintering of fly ash obtained from various Indian steel plants.

(iii) *Use of fly ash for land reclamation*

Fly ash or any other ash can be conveniently used for land reclamation work by mixing it with water to make a slurry and dumping this slurry over the area to be reclaimed. The economy with respect to the cost of transportation of the ash or slurry should, however, be investigated before reclamation is put into practice. If the cost of transportation exceeds the cost of some other local materials, the use of ash will prove to be false economy. A typical example of reclamation work using fly ash is the Kincardine power station of the South of Scotland Electricity Board. It has been constructed over reclaimed land and the fly ash produced by the plant is being used for further reclamation work. The ash is mixed with sea water drawn off from the circulating water system of the power plant. The slurry so formed is transported through pipes to the site to be reclaimed using disposal pumps.

Cinder

The major sources of cinder are furnaces and steam locomotives in which coal is used as fuel. The residue in these cases includes a large percentage of cinder. It offers scope for its economic utilization in the manufacture of precast concrete blocks, concrete floors, foundations, and as an aggregate for concrete. It is particularly suitable for use in low cost housing schemes. However, the main disadvantage of cinder for use in reinforced concrete work is that it adds to the corrosion of the reinforcement.

Paper industry wastes

The economic utilization of paper industry wastes presents a number of technical problems of varying nature. For example, the requirements of industry necessitate treatment of large quantities of papers, resins, metallic foils, plastics, etc., and it is likely that minute quantities of treated paper may pass undetected into the pulping plant. Such an occurrence will spoil a complete batch of paper. It is, therefore, essential that before reuse the paper wastes coming from various sources are carefully sorted to remove the harmful elements. A look at a heap of waste paper will clearly show the immense difficulty and labour involved in segregating various kinds of paper. The attempts to find an economic solution to this problem have not yielded satisfactory results so far.

Other types of wastes associated with the paper industry are those which are produced during the manufacture of paper. These include pulp mill wastes, reutilization of which is not likely to result in any economic advantage in view of the small quantity of the waste ; (ii) bleachery waste which is concentrated and hard, and therefore presents difficulty in handling and transport; (iii) waste liquor which comes out of the pulp; and (iv) waste out of the machines converting pulp into paper. In the absence of any process for their remunerative use, the present practice consists in their disposal to rivers, streams, etc.

Coal washery slurry

Upgrading of low grade coal is generally carried out by the wet process which results in the formation of large quantities of slurry. In view of the increasing number of coal washeries in India, it is essential to pay greater attention to the problem of recovery of fine coal and clay slimes from the circulating water so that it may again be used for the washing process. This is important from the viewpoint of conservation of water and also for avoiding stream pollution. This can be achieved by developing suitable thickeners having flocculating agents which can improve the settling rates of solids.

Water works silt

Huge quantities of mud or silt are precipitated in all water works, especially in those which employ water from heavily silt laden rivers, a typical example being the Calcutta water works. This silt has desirable properties recommending its use for the manufacture of brick and expanded lightweight concrete. However, suitable methods have yet to be developed for such uses of this silt.

Plastic wastes

The modern trend towards increasing use of plastics in practically every sphere of industrial activity has resulted in an increase in the production of plastic wastes in the same ratio. The thermoplastic wastes present no difficulty as they can be easily reutilized in the manufacturing industry itself. Thermoplastic wastes can be recycled without any appreciable change in properties. Thermosetting plastic wastes, however, do not lend themselves to any economic re-use, because once they are set they cannot be brought back to their original structure by melting or any other chemical process.

Paints

Spray painting is widely used in modern industries. The process invariably results in the production of large quantity of wastes in the form of overspray paint which gets deposited on the walls of spray booths. Generally, it is scraped and dumped after it hardens. The very large quantity of waste paint produced regularly demands a deeper probe into the methods of its economic re-utilization.

3. Sewage and domestic refuse

Sewage is a waste which is produced in quantities far exceeding that of other wastes. It is natural, therefore, that maximum attention has been given to finding out new ways and means to utilize it to produce various useful products.

Sewage contains about 99.5% water and the rest includes suspended solids, phosphates, potash and nitrogen. The recovery of these materials from sewage is economically unattractive. The only components of sewage which can be economically utilized are water and sludge.

Utilization of sewage effluents

The water in sewage can be purified by chemical or biological treatment and then mixed with fresh potable water. This method of water re-utilization is of importance in densely populated and highly industrialized areas where conservation of water offers appreciable economy in the working of water supply systems.

The use of sewage effluents for irrigation of agricultural land has been attempted in the U.S.A. and the U.K., with promising results. Another use of sewage is for recharging underground water bearing formations. In this case, due precautions have to be taken to prevent contamination of ground water.

In the vicinity of a steel plant or a power house or any other industrial undertaking requiring cooling water, sewage can be filtered to remove the suspended matter and the filtrate used as cooling water. The residue on the filters is called 'primary' sludge. This, along with some 'secondary' sludges obtained by biological oxidation of organic matter in settled sewage; can have two important and useful applications:

(1) Production of high heat content combustible gases by anaerobic digestion of the sludge. This also reduces the bulk and odour of the crude sludge.

About 70% methane can be produced by this method. This quantity may be sufficient to make the running of the sewage treatment works independent of the outside power, by utilizing the gas for the production of electrical power.

(2) Sewage sludge has proved to be a valuable fertilizer and soil conditioner. However, the sludge has to be suitably prepared before it is used as a fertilizer to prevent odour, grease and bacterial contents. The suitability of the sludge as a fertilizer results from its high nitrogen and phosphate contents. Since the value of sludge as a fertilizer increases as its nitrogen content increases, attempts were made to develop methods of processing the sludge to increase the nitrogen content. It was found that up to 5% increase in nitrogen content can be achieved by heat drying the activated sludge. Besides, useful manure can also be obtained by composting of sewage sludge with dry organic materials such as domestic refuse. Development of methods for economic production of fertilizers from this source will contribute significantly to the economy of nations where agriculture predominates.

4. Radioactive wastes

As the major sources of radioactive wastes are the reactor fuel reprocessing plants, the problem of their disposal or re-utilization has not attracted as much attention in India as in the U.S.A., the U.K. and other advanced countries where the nuclear industry has developed considerably. However, with the rapid industrial development of the country, it is certain that the existing power resources will not be able to cope with the demand resulting in the increasing use of nuclear fuels, and then this problem will come to the forefront.

There are also other types of radioactive wastes which originate from mining of uranium, chemical and metallurgical reactor fuel making operations, research operations, reactors (both air and water cooled), etc. There are almost as many types of radioactive wastes as there are radio isotopes produced in the reactors and laboratories. In handling such wastes, the nature of the specific waste material under consideration and the rules and specifications for human safety must be borne in mind. Little effort has so far been directed towards the re-use of radioactive wastes as such efforts are not likely to yield any tangible result; but the problem of their disposal demands careful consideration in view of the harmful effects of radioactivity on life. The following methods have been used for this purpose:

(i) Storage in tanks: the method offers the advantage that the stored radioactive liquid waste can be reprocessed at a future date. The problems involved in storage are the space required and the danger of excessive radioactivity;

(ii) Sea disposal: this is done by placing the material in concrete containers or drums and dumping them into the sea; and

(iii) Disposal into the earth: this is done either through deep wells or old salt and coal mines. This method of disposal is necessary for long lived radioisotopes which cannot be destroyed, with the result that their potential danger can neither be reduced by chemical means nor mechanical means.

The only way in which radioactive wastes can be put to some economic use is to separate the long life radioisotopes such as strontium 90 and cesium 137, which have a life of 28 and 27 years respectively. These isotopes, particularly strontium 90, is useful as a radiation source as it has substantially energetic beta and gamma emissions. This also reduces the radiotoxicity of the waste which facilitates its disposal. However, the associated problems of high heat production and air cleaning impose severe limitations to such processes.

In addition to the major types of industrial and other wastes and scrap mentioned so far, there are certain categories which do not lend themselves to any beneficial use either due to their small quantity or due to the difficulty in processing them to recover any useful product. It will not be out of place to give a brief account of such wastes here because they often affect the economy of operation of sewage collection systems and treatment plants by contributing loads in excess of the system or the plant capacity or by contributing objectionable contaminants, thus necessitating treatment before disposal to the sewage system. The important types of such wastes are:

(i) Laundry waste: these may include soap suds, rinse water, grease, dirt, detergents, etc. These may have an adverse affect on aeration and digestion processes;

(ii) Dairy waste: these consist of buttermilk, washings from cans and bottles, spoiled milk, milk products, etc. They emanate bad odour and also cause clogging of filters;

(iii) Distillery waste: these include malt and yeast; and

(iv) Tannery wastes: these include wastes containing hair and fleshing.

5. Conclusion

The rapid industrialization of the country will present additional problems in the economic utilization of wastes. Since our resources are meagre as compared with the pace of industrialization, it would be in the interest of national economy if greater research and investigation is directed towards economic utilization of wastes.

6. References

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SIXTH WORLD PETROLEUM CONGRESS, FRANK-FURT-ON-MAIN, JUNE 19-26, 1963

After a space of four years, the petroleum industry from all over the world will again be able to exchange scientific and practical experience at the sixth World Petroleum Congress, which is to take place in Frankfurt-on-Main, West Germany, from June 19 to 26, 1963. The preparatory committee is actively at work on behalf of the Permanent Council of the sixth World Petroleum Congress to provide the organizational and scientific prerequisites for a successful and undisturbed running of the event. Over 5,000 to 6,000 visitors from more than 60 countries are expected to arrive in the historic city of Frankfurt, the scene of imperial coronations and trade fairs, the birthplace of Goethe where he spent the days of his youth and childhood, the seat of the Bundestag and the first German National Assembly, with a population of close on 680,000, one of Germany's most impressive cities.

The Congress is to be opened with an official reception and is to take place in the Congress Hall of Frankfurt-on-Main's fair and exhibition grounds which is fully equipped with all the technical installations necessary for a modern international congress. Thus, there will be a simultaneous interpretation system working by radio which will permit each participant to follow the papers and discussions in one of the official Congress languages (German, English, French). For, hardly ever before, seen from the point of view of science, technology and economics—has petroleum exploration, recovery and refining made such great progress as in the last four years. The very names of those who have written and are to read the three main lectures convey to the expert that there will be no better opportunity than Frankfurt-on-Main to see the present level of petroleum research. J. H. London, President of the Board of Directors of the Royal Dutch-Shell Group, will deal with the subject 'Speeding the Pace of Technological Development'; N. J. Rathbone (U.S.A.), President of the Standard Oil Co., New Jersey, will discuss the subject 'The Contribution of Oil to Our Civilization'; and A. Giraud (France), Ingenieur en Chef des Mines, will speak on 'Progress Scientifique et Evolution Industrielle dans le Domaine du Petrole'.

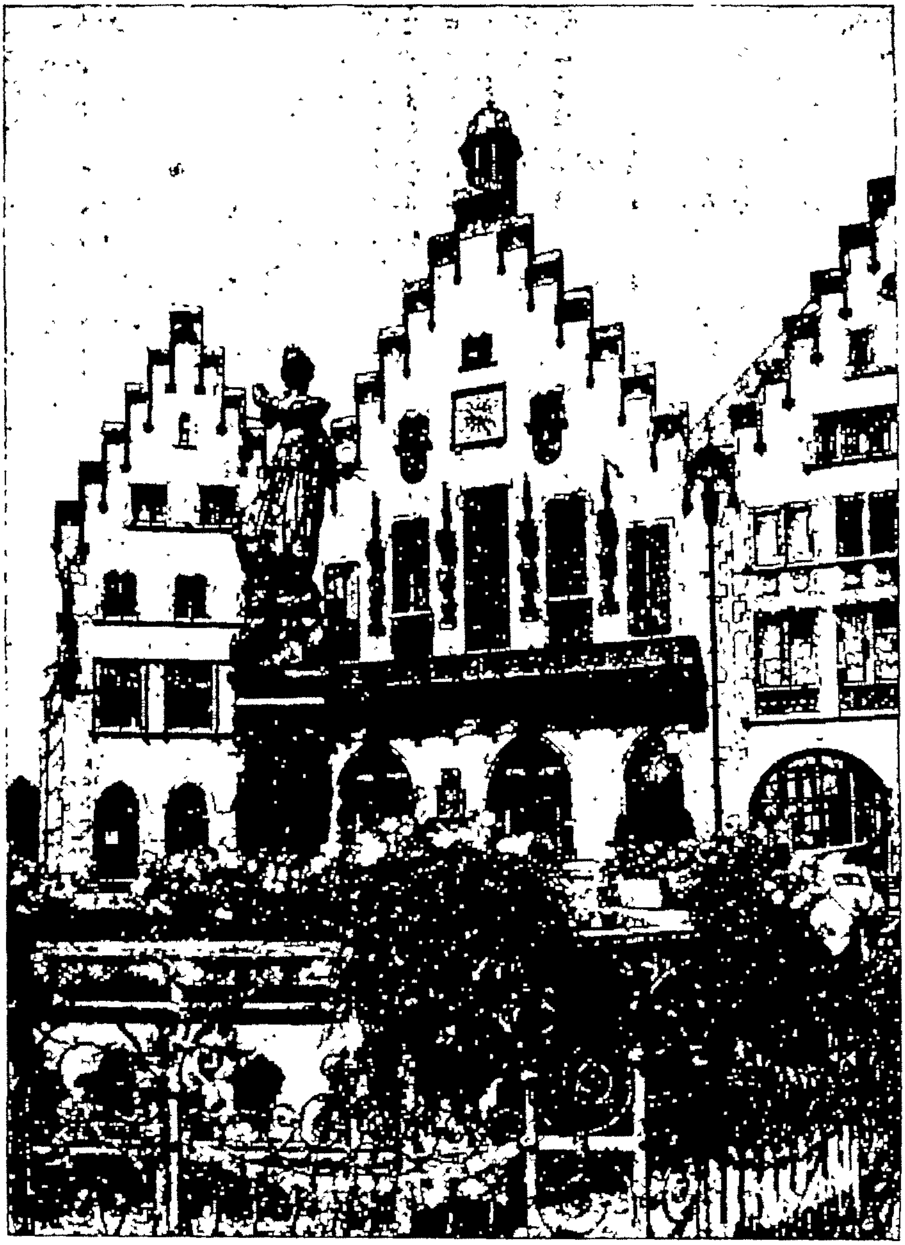
The four review Papers ('Exploration' by L. G. Weeks; 'Drilling and Production' by R. Roberts, 'Refining and Petrol-chemicals' by W. Thies; and 'Utilization of Petroleum Products' by C. D. Davies) will be arranged at such times during the Congress as to enable all participants to hear them. Well known representatives from 36 countries will take part in the 240 papers dealing with all fields of petroleum geology, exploration, drilling, recovery, refining and utilization.

Apart from this, those interested will have ample opportunity for a fruitful exchange of ideas with representatives of their particular fields—the value of which every visitor to a large congress readily appreciates. To give participants an opportunity to broaden their knowledge, one-day scientific excursions are planned for the day before and two days after the Congress. These will include visits to plants of the petroleum industry, enterprises of the general chemical and petrochemical industries, steel production plants and instrumentation construction enterprises.

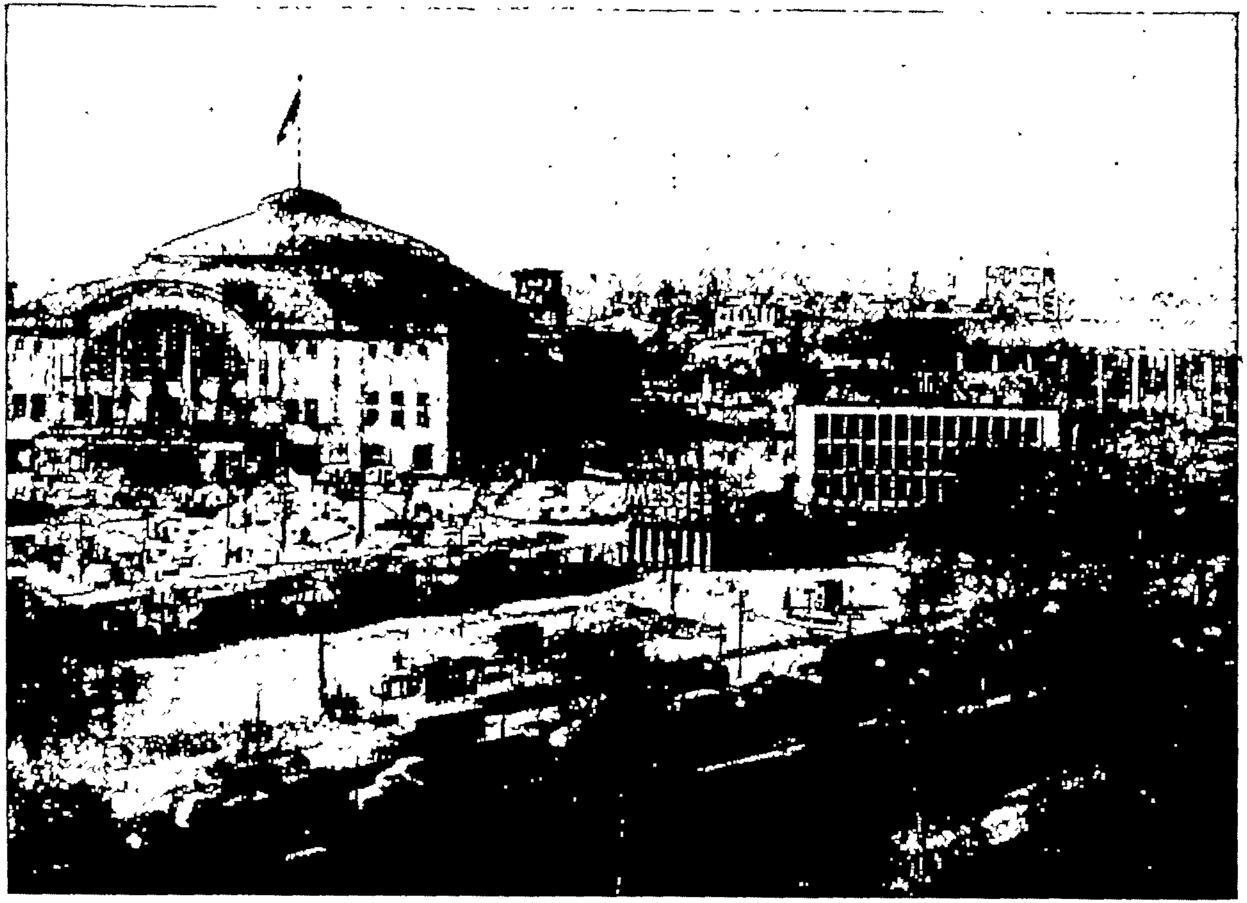
Compiled from material supplied by the General Secretary, Sixth World Petroleum Congress.

The house where Gœthe was born

Eschenheimer Tower, the proud witness of the middle ages



The ancient Town Hall Romer



Exhibition ground and Congress Hall

Another view of Exhibition ground and Congress Hall

Geological excursions will be conducted near Hannover, where oil has been struck, and in Upper Bavaria, as well as the northern foreland and southwestern edge of the Harz mountains. Apart from this, participants will be given the opportunity of continuing the excursions into the neighbouring countries. Visitors who wish to inform themselves on the present level of research will be provided with a great range of possibilities as has very probably never been offered them before in such variety.

In connection with the Congress, a big international exhibition of the equipment supplying industries is to be held and will bear the name 'Inter-Oil.' The exhibition will be accommodated in 71,760 sq. yards of hall space and 203,320 sq. yards open air space. In nine main groups, suppliers of the petroleum industry will exhibit everything that is necessary for petroleum and natural gas prospecting and exploration, drilling and recovery, refining and utilization, as well as for storage, transportation and distribution, including the necessary techniques of measurement, control and automation in plant and laboratory, and accident prevention and labour protection.

An accompanying programme of social events will cater for relaxation and entertainment and will not only acquaint participants with the city of Frankfurt-on-Main but also with its charming surrounds further afield. The climax of the programme will be on Sunday, June 23, 1963, when a trip on the Rhine between Rudesheim and Sankt Goar will take place. All Congress guests and their ladies will be welcome.

The Institution of Engineers (India) has been the Indian National Committee for the World Petroleum Congress since 1950.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Bihar Centre

Chairman's address by Shri K. N. Rohatgi, B.Sc., B.C.E., M.E., M.I.E., at the 15th Annual General Meeting of the Centre on January 8, 1962

The Chairman welcomed the Chief Guest, B. Paswan Shastri, Minister for Public Works, and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

During his address, Shri Rohatgi described the past important activities of the Centre and then briefly described the activities of the various engineering organizations and departments in the State in the following words.

Irrigation

'The expansion of the Irrigation and Electricity Departments was taken up as far back as 1947-48 with the result that much progress could be made by the State during the last two Plan periods. But, as no major scheme was carried out by these departments before the First Plan, the State continued to lag behind.

The irrigation plan for the State consists of nine spillover schemes and 19 new schemes. The bulk of the expenditure on spillover schemes will be on the Kosi, Gandak and Sone barrage schemes. The irrigation benefits from the Kosi east canals are estimated at 1,400,000 acres and 400,000 tons of food crops. It is proposed to take full advantage of the barrage by extending irrigation to the west bank and to those areas on the east bank which had not been originally included in the scheme due to certain technical difficulties.

Work on the Gandak project will also be continued in the Third Plan. The project is intended to provide irrigation facilities to 3,162,000 acres in Bihar (of which 2,550,000 acres are culturable), 831,000 acres in Uttar Pradesh, and 140,000 acres in Nepal.

The Sone barrage scheme has been taken up, as the existing anicut across the River Sone was found to be inadequate and a new barrage six miles upstream was considered necessary. The scheme consists of the barrage, two high level canals, and remodelling of the distribution system. Nearly 90% of the remodelling work is estimated to have been completed by the end of the Second Plan. Approval for the Sone barrage project excluding the high level canals is already available, and preliminary work has commenced. The total estimated cost of the project, including the high level canals, would be Rs. 20.69 crores. The additional irrigation potential created by the end of the Third Plan would be 307,000 acres.

The irrigation potential created and utilized or proposed to be created and utilized through major and medium irrigation schemes at the end of the Third Plan are given below.

Potential	Pre-plan	By the end of First Plan	By the end of Second Plan	By the end of Third Plan
		Acres		
Created	997,000	1,459,000	2,066,000	4,848,000
Utilized	997,000	1,262,000	1,869,000	3,856,000

Flood control

An expenditure of Rs. 5.61 crores was incurred on flood control measures during the First Plan period, followed by an estimated expenditure of Rs. 17.69 crores in the Second Plan, including that part of the cost of the Kosi project which is allotted to flood control. During the two Plans, an area of nearly 20.75 lakh acres has been protected from floods. Flood control and drainage are to be taken up to cover the remaining flood affected areas in the Third Plan at a total cost of Rs. 9 crores and are likely to afford flood protection to an additional area of about 350,000 acres.

Power

The programme for power development, which has been given priority in the Third Plan, is estimated to cost Rs. 79.95 crores, of which Rs. 70.62 crores have been provided in the State Plan. The State's share of expenditure on the power projects of the Damodar Valley Corporation would be Rs. 20.04 crores. Of this amount, Rs. 15.04 crores will form part of the State Plan and the remaining Rs. 5 crores is to be obtained from the Central.

Generation of additional power on a large scale is being taken up by the State Electricity Board in the Third Plan. In the Second Plan, work was commenced on the installation of two units of 15 MW each at Barauni and two units of 50 MW each at Patratu for which the preliminary work has been done. Proposals sanctioned by the Planning Commission include the augmenting of the capacity at Barauni by 75 MW and that at Patratu by 250 MW. The Kosi hydel project is designed for 20 MW and the Gandak project for 15 MW.

Along with generation of power, the Board will also construct 630 miles of extra high tension transmission line in north Bihar, south Bihar and Chotanagpur. High tension transmission and distribution lines will cover nearly 500 miles. The rural electrification programme will be continued and about 1,037 villages will be electrified, bringing the total to over 3,080.

Even with the additional generation detailed above, the State will continually face shortage of power. The per capita consumption of power in Bihar in the Third Plan is expected to rise from 36.9 units in 1960-61 to 74.9 units in 1965-66 as compared with 49.2 to 83.4 units in the country. The increase in the demand for power can be met only when power plants are manufactured within the country.

Public health engineering

The activities of the Bihar Public Health Engineering Department embrace the execution and maintenance of (i) the National Water Supply and Sanitation schemes, (ii) the water supply, drainage and sanitary installations in Government buildings, and (iii) maintenance and running of State owned water supply and other schemes on behalf of the local bodies.

The Government of India has embarked on a nationwide programme of water supply and underground drainage in urban and rural areas. The Bihar State incorporated programmes in its first two Plans and is continuing the urban schemes in the Third Plan.

For urban schemes, 100% loan, and for rural schemes, 50% loan and 50% grant are advanced by the Central Government. The State Government has sanctioned 50% loan and 50% grant for urban water supply schemes, 25% loan and 75% grant for urban drainage schemes, and 100% grant for rural schemes.

Piped water supply has been provided for 29 cities in the two Plans. Also, substantial improvement of the old water works at Patna, Muzaffarpur, Gaya, Daltonganj, Bhagalpur, Monghyr, Jharia, Arrah and Sonepur were carried out.

Only three sewerage schemes were carried out during the two Plans, two minor schemes at Rajgir and Bodh Gaya, and one major scheme in Patna (this work was done by the Patna Improvement Trust).

In the Third Plan, in addition to completion of spillover water supply schemes at Dinapore, Hajipur, Colgong, etc., new water supply schemes will be taken up at 14 places.

Due to paucity of funds in the Third Plan, sewerage for only a part of Patna will be provided. Also, a sum of Rs. 8 lakhs will be available for sewarage schemes for Gaya, Muzaffarpur and Ranchi, but this is very inadequate. Efforts should be made to get the Plan provisions for urban water supply and drainage increased.

Rural water supply

In addition to the schemes already completed and those to be taken up under the National Water Supply and Sanitation Scheme (Rural), work has been done for supplying safe drinking water to villages in the State during the two Plans. Due to the decision of the Government of India to include only schemes with network distribution system in the National Water Supply and Sanitation Scheme (Rural), sinking of 1½ in. tube-wells fitted with hand pumps had to be done entirely out of the State's resources. It goes to the credit to the State administration that they sanctioned sinking of 2,000 tube-wells in villages during 1951-52, and 10,000 in 8,300 villages of north Bihar which were badly affected by floods in 1954. Subsequently, a large number of tube-wells have been sunk in north and south Bihar. It is understood that a large number of tube-wells have been sanctioned for villages in south Bihar which were affected by unprecedented floods in 1961. Early sinking of tube-wells in the villages is essential for reducing incidence of gastro-intestinal diseases. The capital cost of sinking a 1½ in. tube-well which can serve about 200 persons is Rs. 400 to

Rs. 800 and the recurring cost is Rs. 40 to 50 per tube-well per year. In the whole of north Bihar and the greater part of south Bihar, tube-wells can be sunk successfully as the sub-strata is alluvial.

In spite of occasional strikes by scavengers, the Government do not seem to be sufficiently alive to the necessity of providing sanitary latrines in Government offices and quarters. This is a matter in which the Government should provide a good lead to the public by converting service latrines into sanitary ones.

Another point is the absence of laboratories where samples of water could be tested. Samples of water have still to be sent from remote corners of the State to the Public Health Institute at Patna for testing. It should not be difficult for the Government to provide in each district and even in the sub-divisions small laboratories for the purpose. Through the Indian Council of Medical Research, a small laboratory was established at Naugachia for testing samples of water. This very much facilitated sinking of tube-wells in the neighbouring *thanas* where a number of them had to be re-sunk because samples of water from the original sites contained excess of iron.

Substantial work has been done by the Hatia Branch of the Public Health Engineering Department, which is carrying out the industrial water supply schemes of Hatia, Adityapur, Bokaro, Barauni, Mokameh and Patratu thermal power stations. By the end of the Second Plan, nearly Rs. 61 lakhs will have been spent on Hatia water supply and nearly Rs. 30 lakhs on Adityapur water supply. At Barauni, data regarding the quantity and quality of underground water in that area are being collected from an experimental tube-well of 18 in./15 in. size sunk to a depth of 300 ft. Investigation is proceeding as regards supply of additional 10 million gallons per day of water to Ranchi and 12 million gallons per day to Adityapur from the Getal Sut dam on River Subarnarekha.

Buildings and roads

Substantial work has been done by the State Buildings and Roads Department during the last Plan periods. Among the important works, mention may be made of the new Secretariat, the Ranchi Medical College and Hospital, the Heavy Insulator Factory at Namkum, the various engineering colleges and schools, expansion of the Patna Medical College Hospital, the combined offices at several district headquarters, and a large number of residential flats and quarters.

At the end of the Second Plan, there were about 8,000 miles of roads in charge of the State Public Works Department, of which 5,300 miles were metalled. There will be 9,300 miles of roads in the State by the end of 1966, of which 7,000 miles will be metalled. In the Third Plan, sufficient attention has been given to the construction of bridges.

Recently, the World Bank in collaboration with the International Development Association has allowed credit worth Rs. 14.45 crores for the development of some of the National Highways, *i.e.*, (i) Barauni-Khagaria-Kursela-Purnea, (ii) Barauni-Dalsingsarai-Muzaffarpur, and (iii) Ranchi-Jamshedpur-Bahargora, and for the construction of bridges over (i) the Sone River at Dehri-on-Sone, (ii) the Kosi River at Kursela, (iii) the Burhi Gandak River at Khagaria, and (iv) the Mahananda River at Dingraghat. These works are to be completed by September 1964.

In 1961, the mileage of surfaced road for a population of 100,000 in this State was 163, as against 445 for the country. On area basis, the mileage of surfaced roads per

1,000 sq. miles was 95, against 148 for the country. The task to be fulfilled is, therefore, of a large magnitude.

Town planning

There is a State Town Planner in the Local Self-Government Department who looks after the preparation of the master plans for Gaya, Ranchi, Muzaffarpur and Bhagalpur. At each of the above towns, there is an Improvement Trust. The Gaya Improvement Trust has done some work in the Second Plan, while others are likely to do so in the Third Plan if funds are available.

The Patna Improvement Trust has been functioning since 1954. It has constructed a colony in Patna called Rajendra Nagar. It has also carried out extension of sewage disposal works at Saidpur and has laid storm sewers in central Patna. Its scheme no 2, which comprises improvement of the Fraser Road, the Patna-Gaya Road, a part of Hardinge Road, etc. is in progress. Appreciable work has been done, and if the present tempo continues, the western part of central Patna would become beautiful in the near future. Unfortunately, the Trust, which is supposed to design and carry out sewerage schemes for Patna has done comparatively little work in respect of soil sewerage, which would have improved the sanitation in the city.

Industries

Good progress has been made by the Heavy Engineering Corporation Ltd. on the erection of the Heavy Machine Building and Foundry Forge plants and the township. Similarly, the Hindustan Steel Ltd., which has shifted its headquarters from Delhi to Ranchi, is constructing its offices and quarters at Doranda (Ranchi). It has also undertaken preliminary works for the fourth steel plant at Bokaro.

The National Coal Development Corporation Ltd., which is also an undertaking of the Union Government with headquarters at Ranchi has completed a number of works in the Second Plan for improving and developing the collieries and attached residential colonies.

The High Tension Insulator Factoryat Namkum (Ranchi), which is a State Government undertaking, has started manufacturing insulators.

The capacity of the Superphosphate Factory at Sindri, another State Government undertaking, is being expanded.

A modern coal washery has been commissioned by the Hindustan Steel Ltd. at Dugda recently.

In the private sector, the Tata Iron and Steel Co. Ltd., the Tata Engineering and Locomotive Co. Ltd., and the Tata-Stewarts Co. at Jamshedpur, and the Rohtas Industries Ltd. at Dalmianagar are also expanding their works. In this connection, mention may be made of the valuable work being done by the Chaibasa Cement Works of the Associated Cement Cos. Ltd. in manufacturing cement from slag obtained from the Tata Iron and Steel Co. Ltd.

A new paper factory is under erection at Samastipur. Two new steel fabrication works for making railway wagons are under erection at Jesidih and Mokameh. Also, a new spinning mill sponsored by the Cooperative Department is under erection at Mokameh.

The Pradeep Lamp Works in Patna which manufactures electric lamps, has undertaken to manufacture all varieties and sizes of electric lamps, medium size transformers, etc. in collaboration with Mishubee of Japan.

The industrial Estates opened by the State Government at Patna, Ranchi, Bihar Shriff, and Darbhanga are quite popular. Small scale industries are also being helped by the Union Government.

There is large scope of manufacture of consumer goods like sanitary wares, household articles, electrical appliances, hardware, door and window fittings, etc. It is evident that there is large scope for industrialization in Bihar, particularly in north Bihar, where a large portion of the population has to depend upon agriculture only.

Technical education

There are five engineering colleges and a large number of engineering schools in the State besides a number of polytechnics and industrial schools, but it appears that a number of them have neither adequate staff nor requisite equipment. This needs urgent attention. The services of retired and qualified engineers should be utilized till such time as young engineers with requisite academic qualifications and teaching experience are available.

The large increase in the number of admissions is leading to inefficiency. If necessary, there should be two shifts and for maintaining uniform standards, it is desirable to have common examinations for all the colleges in the State.

In view of the large number of admissions, it appears desirable to have two undergraduate courses—one 'pass' and other 'honours', as suggested by Prof. Grade and as is the practice in the case of arts and science courses.

Railways

The Chandrapuramuri and the Muri-Ranchi broad gauge lines were opened to traffic during the year. The Barauni-Samastipur and the Bukhtiarpur-Rajgir broad gauge lines are shortly to be opened to traffic. Work on Ranchi-Bandamunda broad gauge line is proceeding. Electrification of the grand chord line has been completed up to Gaya.

Post and telegraph facilities

Automatic telephone service has now been extended throughout Patna, and also other improvements in the services have been done ; but it appears that the civil engineering section of the department needs strengthening as most of the postal buildings are still in hired buildings and the postal staff live in sub-standard private houses.

Housing

Good work has been done by the Housing Department of the State in Jamshedpur and Adityapur but so much remains to be done that the department needs large expansion.

In this connection, I like to point out that though the declared policy of the Government is to encourage construction of houses, in practice, it is being discouraged by the high prices of coal, cement, steel and the periodical raising of railway freight. The Government should not charge excise duty on cement and fix the price of steel much above the retention price paid to the manufacturers. As the matter stands, it is not possible to construct even a small two-roomed house with water and electric connections and a sanitary latrine for less than Rs. 8,000. If its annual valuation is taken at 6%, the monthly rent works to Rs. 40. This shows that all possible attempts have to be made to bring down the cost of building materials so as to reduce the rent to a reasonable figure.

General

In recent years, each Works Department of the State has opened a Design and Planning Wing. There are also a number of architects attached to the State Public Works Department. It has to be admitted that in all important projects good design is most important and needs the best brains. As experienced design engineers are in short supply and a number of senior engineers are retiring, it would be advisable if they are consulted on subjects in which they have specialized. In course of time, these consulting engineers would become assets both to the public and the Government.

Ours is a very noble profession as we can positively help the nation in removing hunger, poverty and disease from which the large majority of our people suffer.

I suggest that in view of the glorious tradition of our country where great men always practised and preached service and sacrifice, we should after a certain age devote a substantial part of our earnings and time to the service of the country so that the progress may be accelerated.'

Gujarat Centre

Chairman's address by Shri U. N. Mahida, B.E., M.I.E., at the 2nd Annual General Meeting of the Centre on December 17, 1961

The Chairman welcomed the Chief Guest, Maharaja Fatehsingh Rao, Gaekwad of Baroda and other invitees, and thanked the Committee of the Centre for electing him Chairman for the year 1961-62.

Delivering his address, Shri Mahida spoke on utilization of irrigation water in the following words: 'Large multipurpose river valley projects are constructed for ensuring prosperity. One of their products *i.e.*, power, is utilized almost as soon as it becomes available. On the contrary, there is persistent cry of shortage of electrical power, as the supply has not so far been able to overtake or even reach the increasing demand. Similar situation cannot be said to exist in respect of the other product of these multipurpose projects, *viz* irrigation water in which case utilization lags behind supply.

In an earlier appraisal (Third Five Year Plan—A Draft Outline, published in June 1960 by the Planning Commission,) the utilization of benefits from continuing major and medium schemes of the First and Second Plans was reported at 10,500,000 acres as against 14,000,000 acres actually made available, the State of Gujarat emerging as the worst offender achieving an utilization of barely 245,000 acres as against the available potential benefits of 725,000.

The problem of utilization of irrigation waters made available by the construction of large as well as minor irrigation schemes has been seriously engaging the attention of not only engineers but of agricultural experts and economists. The Central Board of Irrigation and Power and the Ministry of Irrigation have in the past held several seminars to examine this problem in detail. As a result, the Planning Commission has issued several directives advising the State to adopt measures to accelerate the rate of utilization. While some improvement has been noticed in the situation that prevailed some years ago, the lack of balance between available supply and its utilization still persists.

With the investment of large sums in the construction of irrigation projects in the First and Second Plans, large facilities have been created for the development of irrigation throughout India. When the projects were formulated, certain targets for development of irrigation were laid down and it is quite natural that the tax payers are more anxious than the Governments at the non-fulfilment of these targets. The prevailing shortage of foodgrains brings the question of realization of these targets to yet greater prominence, as it was hoped that with the construction of large river valley projects and development of minor irrigation schemes, the country would become increasingly self-sufficient in the matter of food.

Broadly speaking, the conditions hampering speedy development of irrigation have been described as (i) existence of partially inhabited regions in the areas commanded by irrigation canals, (ii) poverty of the ryots, (iii) low prices of agricultural products, (iv) lack of knowledge for changing over from a system of dry farming to irrigated agriculture, (v) high water rates, (vi) ignorance regarding the crop pattern suitable for irrigated farming, and (vii) lack of adequate transport facilities and enlightened publicity. So far as this State is concerned, one cannot complain of the existence of any of these handicaps, except perhaps lack of adequate transport facilities. While the earlier surveys presumed ready availability of irrigation supplies at or near the fields, in the report prepared by me in 1957 for the Central Board of Irrigation, it was emphasized that, in many cases, while projects or sections of projects were reported to be completed and inaugurated with great ceremony, in actual practice, the devices necessary for detailed distribution of irrigation water to the fields were lacking. This brought to the forefront one of the most important factors that hampered the development of irrigation, *viz.*, the lack of adequate distribution channels.

Distribution channels

Even today, the foremost physical difficulty experienced by the cultivators in utilizing water for irrigation is the inadequacy of water distribution system. The extent to which distribution channels are provided by the Government in different areas varies from State to State, but, broadly speaking, the present practice is to construct water distribution system to a certain limit, provide the outlets and leave it to the cultivators to construct distribution channels below this limit. In some States, the channels constructed by the Government go down only to the lower limit of 5 cusec.

while in others, a limit of about 3 cusec. has been adopted. With this arrangement, water was brought by the Government at the head of areas of 300 to 500 acres. With the prevailing sizes of holdings in this country and the stage of fragmentation, it is almost impossible for the cultivators in such large areas to make their own arrangements for taking water to their fields. The difficulties of individual '*bagaitdars*' in leading water to their fields through the fields of other cultivators or even along the boundaries of neighbouring fields owned by other farmers have not been fully realized by those making the decisions regarding the size of the blocks of land to which the channels constructed by the Government should extend.

As a result of several reports and recommendations, the Planning Commission issued in May 1959 the following directives concerning construction of such channels :

(i) The project authorities should be responsible for the construction of water courses at Government cost for *chaks* or blocks up to 100 acres in area. This limit may, however, be varied in different States according to local conditions relating to topography, crop pattern, etc. The authorities concerned should consult local opinion in fixing the alignment of these water courses ; and

(ii) The survey and alignment of field channels beyond the point to which water courses are constructed at Government cost should be the responsibility of project authorities. Responsibility for excavation of these channels should be entrusted to the beneficiaries and they should be helped and organized for this purpose, *e.g.*, by community project authorities, through *panchayats* and cooperatives. If the local people default in the discharge of this responsibility, the State Government should have power through legislation to construct field channels, the cost being recovered from the beneficiaries.

More than two years have passed since the above directives were issued but the present situation reveals that difficulties in the actual construction of channels still persist. The problem must be faced squarely, giving up the prevailing approach as regards the responsibility of the beneficiaries and the influence and efficiency of institutions like the community projects, *panchayats*, and cooperatives.

Measures for agricultural extension and other measures

After the construction of distribution channels, other measures to assist in the task of utilizing water supplies are necessary. As the changeover from dry cultivation to irrigation involves different methods of agriculture, more sustained efforts and larger investments in the initial stages, the cultivators should be helped to enable them to effect the changeover smoothly. As these measures have been discussed at length from time to time in the past, I shall refer to them here only briefly.

(i) *Rural communication*

To ensure rapid and efficient transport of agricultural products, an adequate system of rural communication should be provided in the areas commanded by canals. Sometimes the existing system is generally adequate but requires reorientation. For example, with the establishment of a sugar factory requiring 3,000 to 4,000 acres of cane cultivation and having its plantations spread over some 20,000 acres, the existing network of rural communication may have to be re-aligned to enable the cane to be transported to the factory.

(ii) *Agricultural credit*

As the changeover to irrigated agriculture necessitates some initial investment for levelling the land, building, etc., *tagavi* loans for land improvement may be more liberally given in the irrigated areas in the first few years.

(iii) *Supply of better seeds and fertilizers*

To enable the cultivators to derive the fullest benefit from irrigation, it is desirable that they should use better seeds ; to ensure regular supply of reliable seeds, seed multiplication farms may be established. Also, facilities for timely procurement and distribution of fertilizers may be provided as the manurial requirements of crops under irrigation are high if the fullest benefit is to be derived from the use of irrigation water. Generally, normal supply of farmyard manures is not sufficient to meet the requirements after the introduction of irrigation. To get over this deficiency, free supply of water may be given for green manuring whenever water is available.

(iv) *Warehousing and storage facilities*

To ensure reasonable rates of produce and prevent exploitation by speculative buyers, storage facilities may be provided either by the Government or by cooperative efforts. For both seasonal and commercial crops, arrangements for granting loans against the stored products may be offered.

(v) *Concessional water rates*

To enable the cultivator to tide over his difficulty in the initial period, free supply of irrigation water or water at concessional rate for all seasonal crops may be allowed for a short period. Water supply may be free for the first year, one-half of the rate may be charged for the next two years and thereafter full rates may be levied. This will also give time for the irrigation distribution system to be tested and stabilized. Also, betterment levy which is to be recovered in instalments may not be recovered before five years after the introduction of irrigation in the areas concerned.

(vi) *Measures for economical use of water*

To ensure economical use of water, its regulated distribution and timely supply and to prevent harmful effects of excessive use of water, which mostly follows the introduction of flow irrigation, experimental research stations should be established to study the problems of application of water to crops, the pattern and measures of distribution, measurement and control, and the modes of dissipation of water applied. Harmful effects of excessive supplies giving rise to waterlogging and salt efflorescence have to be studied and measures for their prevention and recurrence have to be taken up by experimental field research. The spread of waterlogging and salt efflorescence in irrigated areas causes apprehension in the minds of prospective irrigators that introduction of irrigation may also cause damage to their lands. Unless measures for the prevention of damage and amelioration are devised, they are unlikely to have the enthusiasm to use irrigation water.

(vii) *Agricultural demonstration and crop planning*

Introduction of irrigation not only guarantees maturing of crops normally grown in the area but can change the crop pattern itself by providing facilities for raising better and higher rated crops. To accelerate development of such crops and study the variety of crops best suited to the new development and to assess their manurial and other requirements, research and demonstration farms should be established. Such farms would go a long way in introducing and popularizing the type of crop planning best suited for a project. Little crop planning is done nowadays even while embarking on large and costly schemes. This defect needs to be remedied, as in a planned programme of agricultural production under conditions of controlled water supply, systematic crop planning can go a long way in augmenting and stabilizing production. It must be emphasized that irrigation systems provide the best field for such planning as apportionment and supply or withholding of irrigation water can be of aid in the introduction of the desired crop planning.

(viii) *Miscellaneous*

Growth of multipurpose cooperative societies should be encouraged for purchase and distribution of seeds, manure, implements and sale of produce. In all the activities referred to above, the greatest advantage should be taken of the National Extension Service activities in the area. This institution can render yeoman service to the cause of development of irrigation. While the prevailing tendency appears to be to concentrate on road building, building of schools and dispensaries, etc., greater attention needs to be directed to the less spectacular activity of extending production in the irrigation areas. To facilitate this, it would be advisable in some canal areas to place a small section of the National Extension Service workers at the disposal of the local irrigation officers. They must first receive training in the distribution of irrigation water under the guidance of the irrigation staff and then be available to the irrigation officer for manning his developmental wing.

(ix) *Irrigation management*

Apportionment, sanction, regulation or timely distribution of water supply, subsequent measurement of areas irrigated, assessment of water rate dues and panel assessments—all these functions collectively referred to as management of irrigation—should be carefully taught to young irrigation officers by experienced engineers. They must be made to realize that irrigation management is a specialized field of activity and if full advantage is to be derived from the large investments made on the works under their charge, they must regard this branch of their activity as of equal importance to the more spectacular constructional activity. Even the irrigation engineers specializing in construction would benefit considerably if they make themselves familiar with the problems involved in this branch of the activity of the irrigation engineer, as an insight into the requirements of this phase of the activity will enable them to design their works and distribution system with greater efficiency and accuracy.

Optional system of irrigation

Once proper facilities for the distribution of water to the fields are available, the reason for lack of utilization has to be looked for. The causes lie mostly in our 'methods' and 'contract' of supply of water, which may be broadly described as the optional system of irrigation.

The prevailing pattern of irrigation in most of the States is that water is supplied to cultivators who apply for it and water rates are charged on the area actually irrigated, the rates varying according to season or the type of crops raised or both. As irrigation is not confined to arid areas, the extent of area irrigated and consequently the water utilized vary from year to year within wide limits. In years of average to good rainfall, seasonal irrigation is considerably reduced and the supplies available remain unutilized. Not only this, as the rainfall is hardly ideally distributed throughout the season, the production is also reduced considerably. Even with average rainfall, the outturn of crops depending on rain cannot be as good as that possible under controlled and regulated supply of water. This reduction in irrigated area results, on the one hand, in a fall of the revenue and on the other, the uncertainty of demand throws a heavy strain on the management of irrigation canals, which cannot be run at maximum efficiency when the demand is spasmodic. Often, the rainfall is quite satisfactory in the beginning of a season and this tempts the cultivators to withhold the use of canal water, hoping for the maturity of their crops on rains and thereby escaping the water rates. If the rains fail subsequently, crops already grown begin to wither and there is a sudden clamour for the supply of irrigation water. It is impossible to rush water to all the demanding areas in a short time, as the canals and distribution systems cannot be designed to carry such abnormal demands. The result is that crops suffer considerably even though water is available at the source. Weaning of the cultivators away from this habit can be achieved by patient and prolonged education and effective and intelligent propaganda. Herein lie the merits of demonstration farms, education films and practical agricultural training. But, even with all this, the instinct to gamble on rain and the lure for saving a few rupees of water rates are so powerful that the habit persists even in areas where irrigation has been practised for a long time and the benefits of irrigation have been brought home not only by demonstration and education but by the actual results achieved by the community at large. This is clear from the wide fluctuations in the areas under irrigation even in older and established systems with assured supplies of water. As this state of affairs brings loss of revenue, prevents the agriculturist from reaping the full benefits of the irrigation facilities provided at great public expense, results in shortfall of production, and exposes the nation to undesirable international relationships by being forced to import large quantities of food at a time when the position regarding foreign exchange is most acute, the situation should not be allowed to persist for any length of time.

Need and justification for compulsory measures

Irrigation facilities can be availed of only by a favoured few whose lands are commanded by the canals, though the lands in the neighbouring villages may continue to suffer from draught. Even after this, if the facilities are not availed of, a degree of compulsion is justified in the national interest.

Introduction of the compulsory measure may raise justifiable demands for other consequential measures such as provision of warehousing and marketing facilities on a scale much larger than has been possible hitherto, development of rural communication, agricultural credit, distribution of good seeds, and stabilization of prices of agricultural products. But, as these measures are justifiable independently of the proposed measure of compulsion, their need should not be considered as arising from the compulsion proposed. Moreover, the compulsion is merely designed to provide an incentive to the cultivator to use the water and give them full liberty to raise any crop, to vary the crop pattern from time to time, and thus leave him free to make the best use of the land.

The tendency to gamble on rain to save payment of irrigation rates must be effectively curbed by a system of compulsory levy designed to provide an incentive to the use of irrigation water. With the prevailing shortage of food production and the dearth of raw products for industry, agricultural production becomes completely a public function and the Government would be fully justified in enforcing a degree of compulsion in the use of available water facilities and in the application of lands under the command of canals to a regulated use.

In a planned economy, the society directly controls the volume and kind of production of goods, the flow of capital into various industries and, to a certain extent, the technical methods of production. In short, the Government regulates, in an ever increasing measure, the productive activities of the society. It should, therefore, be quite reasonable to impose a degree of regulatory compulsion on the land use programme wherein public funds are invested.

Also, it is reasonable to expect that people receiving this favoured treatment should (i) necessarily utilize the facilities provided, and (ii) wherever possible, they should not be a permanent burden on those not fortunate enough to receive such benefits, or on the community as a whole.

Introduction of irrigation in areas habitually suffering from scarcity or partial scarcity of rainfall puts such areas on par with lands enjoying the benefits of adequate and well distributed rainfall where the land revenue assessment is much higher. Such areas must, therefore, not only avail of the water facilities in a regular manner but also pay for them regularly from year to year, as irrigation provides an insurance against the failure of crops.

As the levy of betterment charges has been more or less accepted, two questions arise : (i) whether the responsibility of paying betterment charges, say, over a period of 20 years, would not in itself provide an incentive, and (ii) whether after the imposition of the betterment levy which is reducible to an annual charge spread over 20 years, the agriculturist can still pay another compulsory levy from year to year.

In regard to the first question, I am of the opinion that payment of betterment charge, which is often justified as a measure for tapping the unearned increment in the value of land resulting from the construction of canals and assumes the character of a capital levy, cannot furnish a permanent and continuous incentive. As the betterment charges can be paid off in lump as cash, or, by surrendering a portion of the land benefitting from irrigation works, or, as an annual contribution over a fixed period of say 20 years, the efforts made and the sacrifices involved in this payment are soon forgotten and the successive generations of agriculturists will hardly remember the payment. The water rights may be acquired by one generation and the charges in the form of betterment levy would be paid off by that generation. The next generation would forget the earlier sacrifices and may therefore continue to enjoy the benefits but with indifference, as no sacrifice is called for. More effective measures to ensure utilization of irrigation water have, therefore to be devised to provide a constant incentive. They need not, however, involve any addition to the total charges otherwise payable. This raises the question of payment of water rates payable from year to year either on a seasonal basis or according to the crops raised and the water consumed. As indicated earlier, some of the causes preventing fuller utilization of irrigation supplies lie mostly in our methods and contract of supply of water which may be broadly described as the 'optional system of irrigation'. This situation can be effectively corrected by a system of water assignment'.

Water assignment

When we expect the cultivators under the command of the canal to use the water facilities, it is quite reasonable for them to expect to know what these facilities are in reasonably exact and quantitative terms, and the facilities must be available to their lands individually, permanently or for long periods. Under the optional system of irrigation, while the total acreage of irrigation possible under a canal system is known fairly accurately, the individual cultivator's quota of different parcels of land are not fixed in advance except under the 'block' and the 'lease system'; these are liable to vary widely from year to year.

No system of canals provides for 100% intensity of irrigation. The overall intensities are of the order of 66 to 80% except in rare cases. Under the optional system of irrigation, apportionment of even the dependable irrigation supplies is governed by factors such as annual replenishment, losses in transit, suitability of soils in different tracts for particular crops, facilities for land drainage, location of consuming centres, etc., the permissible intensities are generally not known to the cultivators sufficiently in advance and are liable to vary in practice from time to time. The proportion of his holding that he can with certainty plan to irrigate over a long period is not accurately known to the cultivator, nor does he know much in advance the proportion of different types of crops he can grow under seasonal or perennial irrigation. There are notable exceptions as in the case of the 'block system' introduced by Sir M. Visvesvaraya in Bombay and the system of 'leases' in some other States, but even these systems are only partial solutions in as much as they provide for only short periods and the option of refusal by the Government at the end of the period disqualifies them as systems under which betterment and compulsory cess can be imposed. But, the pattern prevailing over the country as a whole may be described as 'optional' on either side.

State Governments have generally accepted the principle of the levy of betterment charges and most States have passed legislative measures for their recovery. The Planning Commission and the States have devoted considerable thought on the subject but the approach has so far been mostly exploratory, and little in the nature of betterment levy has actually been collected to-date, though a large number of projects have been under operation for several years. I mention this situation only to bring out its inter-relation with the problem of introducing compulsion. The assessment of the quantum of betterment has been generally related to the increased productivity and consequent increase in the value of land after the construction of a project, but this itself must depend upon the 'specific' benefits accruing to a parcel of land being assessed and not on any overall possibilities over large areas. The extent to which a cultivator can irrigate his holding (as mentioned earlier the overall intensities are only of the order of 66 to 80%), and whether he can raise crops in one season or in two or grow perennial crops in a smaller or larger proportion of his land—all this must be known before betterment can be correctly assessed. While this is necessary, it is not practicable to legislate for a complete, accurate and permanent crop pattern for individual holdings; nor is it desirable to do so as it would result in stagnation, retard development of better crops, and leave little incentive for the introduction of economical methods of cultivation and application of water. It will also render difficult the switching over to different crops to suit prevailing demands. What is possible is to assign a specific quantity of water to a parcel of land, the quantity depending upon the supplies available, the proportion of seasonal and perennial crops considered reasonable on consideration of soil suitability and allied factors, with liberty to the cultivtor to select the crops and alter them from year to year if necessary or desirable, conforming only to a very broad crop pattern but limiting his water requirements to the quota assigned to him. Only with such an assignment can betterment be correctly assessed and irrigated agriculture developed in an organized manner. I mention this to emphasize that water assignment is inevitable even for the limited purpose of the judicious assessment of the betterment.

Compulsion on the cultivator must in turn involve a responsibility on the part of the Government. This is secured by the assignment of specific quantities of water to different holdings of land. This may immediately raise the question whether it is intended to rush to introduce the volumetric method of supply, *i.e.*, the method to charge for water used according to the quantity measured and used and not merely according to areas, crops and seasons. While I recognize the benefits of the volumetric method, I do not feel the need for this method in the present state of development. The quantity of water to be assigned can be determined from the water requirements of crops, as judged from wide experience of irrigation systems and the results of numerous experiments carried out so far.

General agricultural prosperity

Besides the measures referred to so far to promote utilization of irrigation water, there are other measures affecting the agricultural population and calculated to promote general agricultural development, which have to be adopted before success in objectives of water utilization can be achieved. Farmers in irrigated areas are as liable to the shock of economic and trade cycles and the vagaries of price system as other agriculturists in unirrigated areas. Economic welfare of farmers is indirectly affected by Governmental actions other than those which apply to farmers directly. The measures proposed so far for ensuring water utilization and thereby ensuring agricultural prosperity cannot succeed in giving the desired results, if the economic condition of the agriculturists is not conducive to rural prosperity. For these reasons, it was thought fit to invite the attention of the Ministry of Irrigation to the defects and disparities that indirectly act as deterrents to the growth of irrigation.

If cultivators get a high return for their labour and investment by utilizing irrigation water, the normal expectation is that they should readily go in for canal irrigation; yet we are faced with a situation where such water is not being readily utilized.

The reason seems to be that the agriculturist is not convinced that he will get proper reward for his increased labour and investment when he changes over to irrigated farming. This is not merely due to lack of information and education—which can be cured by enlightened propaganda—but the causes are more deep-rooted and appear to arise from the absence of a well defined and coordinated policy of price stabilization and the machinery to implement it.

Under the present circumstances, the agriculturist finds that there is little assurance of reasonable increase in his return in terms of money, though he may feel certain of increased outturn of crops as a result of irrigation. In taking up irrigated agriculture, he changes over from subsistence level farming, wherein his financial liability is practically nothing to an activity wherein he incurs financial liability in the form of larger initial investment and the liability to pay water rates. In the absence of this assurance for a reasonable minimum price, he is naturally hesitant in changing over to the new pattern of farming involving additional investment. I have observed a large number of agriculturists engaged in sugarcane cultivation coming to grief in the past before the control of minimum prices for cane was thought of. The result was that even under well developed canals with established irrigation, the irrigated area reduced considerably. I have also observed the same trends in more recent years. Because of the violent fluctuations in the prices of agricultural products, not only does the development of new irrigation projects slow down but areas actually under irrigation dwindle considerably, however admirably an irrigation system may have been planned and however efficiently managed.

The general opinion of the agriculturists is that they have not been able to share, except for brief periods, the prosperity enjoyed by urban and industrial population. They feel that the price that they receive for their produce is not comparable with the high cost of living imposed on them.

A review of relative fluctuations in the prices of the products of agriculture and the products of manufacture, the measures and policies adopted by the Governments, their hesitation and reversals of policies lend support to the above views. No doubt, there have been efforts at regulation of agricultural prices of both food and other products but a continuity of policy and long term measures appear to be lacking.

The prosperity of farmers results in most cases from high prices for farm products, but the consumers' interests have also to be safeguarded. In a developing economy, food prices generally tend to rise and governmental action to prevent them from rising too high is justifiable. Under economic planning, while the agriculturists should not expect very high prices, they should at the same time be insured against unduly low prices.

In this connection, it would be useful to refer to the situation that arose in 1957 when the Ministry of Food and Agriculture put forward proposals for fixing reasonable minimum prices for important agricultural commodities, urging that the agricultural price support was in the nature of an insurance measure analogous to unemployment insurance and minimum wages in industry. It urged that the minimum price should not be uneconomic to the producer and it should encourage production, especially of the commodities for which higher targets had been fixed in the Plan. It was also emphasized that whenever a reasonable minimum price had been guaranteed as in the case of cotton and sugarcane, production had increased steadily and substantially. It was also generally held that the minimum prices should not be distress prices but should be at levels which would give the cultivators a reasonable degree of assurance so that they could safely invest in agricultural improvements. However, in spite of the recommendations of the States and the acceptance of the proposal by the National Development Council, it was later decided that it was not necessary to fix minimum prices for agricultural products. In the end, the Government merely declared their intention, in their press note of June 14, 1957, 'assuring the agriculturist that the prices of foodgrains and other agricultural commodities would not be allowed to fall below economic levels and that the Government would take suitable steps from time to time to this end'.

When the agriculturist sees that in a planned economy, where the Government controls the volume and quality of production of most goods, the flow of capital is towards industries, almost making a public utility of the important industries, he feels that in spite of the clear tendency in Government policies to enlarge the sphere of social control of production, in the agricultural sector, the price system and markets are allowed very large freedom to control the income of the farmer. He is thus led to believe that even irrigated agriculture cannot bring him the same degree of prosperity as that enjoyed by other economic groups, though this changeover would necessitate an additional investment on his part.

Price stabilization and parity

Unless, therefore, price relations are made more favourable to agriculture, and all or most of the efficient farmers are guaranteed their cost of production and a reasonable surplus, a land use programme cannot be worked steadily and efficiently.

To control inflation, to ensure savings by the middle class and to achieve the Plan targets, one may be inclined to control the price of food and other agricultural products. Urban population agitates for this and the industrialists clamour for it, arguing that the price of foodgrains controls the wage structure. The agriculturist on the other hand feels that while little is being done to ensure him fair price, he is compelled to pay prices often regulated by the Government. Occasional procurement does not help much. He naturally seeks relief from this situation and looks forward to a situation in which he is assured a fair return for his produce comparable to the general prosperity and the cost of living.

There is reason to believe that the situation described above acts as a deterrent to the growth of irrigation and utilization of irrigation water. Ensuring a level of prices which would provide the necessary incentive to the agriculturist, with due regard to the interests of the consumer, should go a long way in the development of agriculture and irrigation.

While a rigid integration of the price structure is neither feasible nor desirable, it should be possible, in the interest of agricultural production to secure to the cultivators minimum prices for the principal agricultural crops including foodgrains. Mere assurance to the agriculturist that the prices of foodgrains and other agricultural commodities would not be allowed to fall below economic levels and that the Government would take suitable steps from time to time to this end is not enough. What is required is the timely and formal announcement and effective enforcement of guaranteed minimum prices.

In 1959, the Agricultural Production Team sponsored by the Ford Foundation, in their report on 'India's Food Crisis and Steps to Meet It', included price stabilization as the first in their recommendations 'Action Highlights'—enabling village farmers to increase production. The following excerpts, though disjointed, attempt to bring out the spirit of their recommendation :

'Indian farmers have experienced wide fluctuations in foodgrain prices during the independence period. These fluctuations have brought hardship both to producers and consumers'.

'Price uncertainties are especially troublesome to the many cultivators who go into debt for crop expenses, and frequently for capital items such as purchase of bullocks. As a result, they hesitate to incur added operating expenses and new investment for expanding production because they are worried that the increased outlay will not be covered by sale of the additional produce. They fear that the price will drop to levels that will reduce rather than increase their net incomes. The price uncertainties of of recent years have been especially serious for small cultivators. They cannot afford to take the risks involved in wide price fluctuations'.

'To encourage increases in foodgrain production, the cultivator should be assured of a price which will enable him to invest in fertilizer, seed and new equipment, knowing that, with average crop conditions, he can repay any debts with the added income that results from adoption of improved practices. Such assurance would constitute an important incentive to increased production.'

Irrigation only an instrument

The justification for stressing these views in an appraisal of utilization of irrigation water made available by collossal investments in the construction of irrigation projects is that in the absence of the measures referred to above, irrigation engineers would be unable to convince the prospective irrigators that increased production by the use of irrigation water will bring them real prosperity, when the agriculturists face them with the arguments that with uncertain agricultural prices and Governments reluctance to guarantee reasonable minimum prices, increased production will bring them little reward for their increased efforts and additional investment.

Irrigation is only an instrument in the scheme of agricultural production; it provides the physical means for the provision of the most important element, the water, necessary for supporting agriculture even under adverse climatic conditions. But its provision can neither automatically solve the social problems created by maldistribution of the national income nor regulate the forces generated by market operations or fiscal and industrial policy. After the organization for supply and distribution of water is rendered satisfactory by providing distributing channels leading to the fields and providing means for the transport of the produce to the marketing centres, the problems that remain to be solved pertain to 'prices and marketing' of the produce. Whatever the facilities for production, transporting, storing and warehousing, ultimately, it is the price structure that regulates agricultural production in a liberal society. The problems involved in this sphere of national activity are beyond the competence of engineers and agricultural experts, and the setbacks or lack of development caused by these forces have to be remedied by economists and politicians.

In concluding, let me answer a possible objection and at the same time indicate a distinct possibility hitherto unrecognized. It may be argued that price control may involve production control even in the agricultural sectors. True, but the irrigation schemes provide ready means and an appropriate field for working out a planned programme of land use—cooperative or otherwise. Assignment, supply and regulation of irrigation water can be used to regulate production'.

Summaries of Papers Published in the Journal, vol. 42, no. 12, pts. EL 6, GE 3 and HI 3, August 1962

ELECTRICAL ENGINEERING DIVISION

Utilization of Hirakud Power for Railway Traction

P. Achyutham
Associate Member

The Indian Railways have an ambitious programme of electrifying the railway system serving the vast industrial belt comprising the public and private sector steel plants, collieries and iron ore mines for facilitating quicker and cheaper transport of raw materials and finished goods. The traction system provides for utilization of electric power at 25 kV. A.C. single-phase, in contrast with the earlier 1,500/3,000 volts D.C. system adopted in some parts of India. In this connection, Hirakud power has played a pioneering role in the field of A.C. electric traction. The problems encountered in making power supply arrangements for railway traction which are of particular interest to electrical engineers are indicated.

Induction Motor with D.C. Rotating Field Equivalent Circuits and Torque-Speed Curves

P. Kundu

The induction motor with A.C. rotating field is extensively used for industrial purposes. It can also be constructed with a D.C. rotating field, though little work has been done on such motors. An induction motor with D.C. rotating field requires a system of four bearings as compared with two in the A.C. rotating type.

To study the properties of an induction motor with a D.C. rotating field, a salient pole type alternator was suitably modified. An analysis of this machine was made with the help of equivalent circuits and it was shown that the machine behaves as an induction motor as well as a short-circuited alternator. Torque-speed curves of the motor were experimentally determined and verified by a quantitative relation derived for the purpose. It was further shown that reactance due to armature reaction actually exists in the above machine as compared with the widely known fictitious existence of it in the alternator.

Analysis of A.C. Magnetic Field in the Nonlinear Region at Very Low Frequencies

R. C. Pal

Associate Member

Eddy current equation in an iron plate exposed to A.C. was first suggested by Thomson in 1892. This equation was solved by several methods under different boundary conditions for the linear region of the magnetization curve, assuming the permeability of the iron plate to be constant. The author has solved the above equation by a new method based on the extension of Crout's method of solving systems of linear equations for the nonlinear region of the magnetization curve. The magnetization curve is represented by an equation in which the ratio of B to H is not constant. The nonlinear differential equation is first represented by finite differences and then the technique of Crout is followed in solving a series of equations by a calculating machine. The method of iteration was used to obtain the final result. Calculated curves using different methods are presented in this paper. The experimental results show that the method is acceptable at very low frequencies and is suitable up to such frequencies as will give a smooth variation of flux density in the solid iron core.

Automatic Voltage Control by Magnetic Amplifiers—3

S. H. Raj

Associate Member

In the first two parts of the paper, the conventional method of automatic voltage regulation using magnetic amplifiers, and the present tendency to adopt automatic voltage control by magnetic amplifiers in light duty alternators such as used for automobiles and in train lighting where a compensation for large speed and load variations have to be made were discussed. The reason for adopting the alternator is to eliminate the commutator in D.C. generation, which leads to reduction in the life of the generator and radio frequency interference. Though the generated alternating voltage has to be rectified again due to large frequency variations, as the load mainly comprises fluorescent lamps, the advent of cheap semi-conductors has solved this problem very efficiently.

In this paper, improvements in the detector stage of the feedback control circuit for frequency and load compensation is suggested and completely transistorized feedback control circuit is introduced. The present trend in feedback control engineering is to adopt controlled silicon rectifiers, and an introduction to this approach is also given.

GENERAL ENGINEERING DIVISION

Management and Administration of Engineering Activities and Their Impact on the Country's Development Programmes

Prof. R. M. Advani
Member

According to Sir Ewart Smith, management may be defined as the organization and control of human activity directed to specific ends. Administration of engineering activities plays a very more important part in the economic prosperity of a country. It is now generally felt that the present system of administration and control of engineering activities, which was designed for just running the day-to-day administration when the number of new engineering projects was very limited, is far from satisfactory for the accelerated rate of industrialization which we now aim at. It would, therefore, be necessary to streamline the administrative machinery by simplifying and rationalizing procedures and methods of work at different levels.

Comparative Evaluation of Fundamental Motion-Time Systems

N. K. Dutta
Associate Member

Evaluation of a fair day's work is of vital interest to all concerned in an enterprise. Management needs it for planning and organizing men, materials, machine and money. Prior to Taylor's approach through time study, the usual way of determining the reasonable output expected from a worker in a day was through guess work by an experienced person. The guess work was found to be inconsistent and not worthy of use as a basis for planning and organizing in a competitive economy. Incentives based on past data have in most cases proved to be unfair and inadequate. Taylor's principle of the 'stop watch' method for time study with certain modifications is being widely used. In establishing time standards by this method, it is essential to rate the worker's speed. To minimize errors due to judgment, the use of objective methods of rating are suggested, but even these do not eliminate the use of the judgment factor. Gilbreths' work on motion study brought in new ideas into this field. These ideas encouraged different consultants and research workers to determine time values of each class of fundamental motion. Commercial predetermined motion systems which give time values for fundamental motions now used in industry are described here.

Efficiency in Civil Engineering

Richard Pfenniger
Member

This paper gives some guidance on how to achieve better efficiency on construction sites. It deals with the construction programme, the weekly programme, the labour and plant requirements as well as with the progress report. It is felt that more use should be made by site engineers of such systematic work.

Man and Outer Space

M. P. Subramonia Iyer
Associate Member

The age we live in today is really a space age, with the dawning of which the riddle of life in other worlds and the exploration and conquest of space have assumed great importance. During the past few years, developments in the science of astronautics have made rapid strides. As days pass by, more and more mysteries of the cosmos are being unravelled, and man is getting ready for his flight to the moon and other planets of the solar system. Already, with the launching of sputniks and manned-satellites round the earth, he has trodden on the once forfidden ground.

The conquest of space is due not only to science but to engineering also. Science gives the 'why of it' while engineering does the 'how of it'. In this paper, the author has tried to briefly explain the various aspects of space travel.

Abbreviations for Metric Engineering Units

J. K. Varshneya
Non-member

The Standards of Weights and Measurements Act, 1956, has placed India on the map of the metric world. The Act lays down a period of 10 years for the complete changeover to the metric system. During the transition period, the various branches of engineering are slowly changing over to the metric system ; but it appears that enough attention is not being paid to the correct, uniform and internationally accepted usage of abbreviations. It is not very uncommon to see abbreviation of kilometre as 'Km' instead of 'km' and of gram as 'gm' instead of 'g'. This paper describes the abbreviations for metric engineering units based on international recommendations by ISO (International Organization for Standardization), IEC (International Electrotechnical Commission), and General Conference of Weights and Measures.

HINDI SECTION

Mandan—the Great Architect of Ancient India

Dr. B. S. Aggarwal
Non-member

This paper gives a brief account of the life and works of the great Hindu architect of the 15th century. He lived during the reign of Rana Kumbhakaran or Kumbha of Chittoor in Rajasthan (1433-1468 A.D.). He designed and constructed the famous fortress of Kumbhal Gark in 1458. He is also said to have constructed the temple of Vishnu 15 miles away from Udaipur. He was also a good sculptor and modelled a number of statues of Hindu gods still existing in the temples near Udaipur. He also wrote a number of books on architecture, the most well known of which is *Prasad Mandan.*

Methods of Building Earthquakeproof Houses

C. Prasad
Non-member

This paper describes the methods by which houses can be constructed to withstand shocks caused by earthquakes. It gives useful hints and directions for constructing such houses in areas liable to earthquakes.

Engineering Mechanics—Statics

B. N. Thadani
Associate Member

This is the second part of a series of papers on the subject of engineering mechanics and deals with statics.

The New Assembly Chamber in Chandigarh

G. R. Nangea
Member

This paper describes the principles kept in view in designing the Assembly Chamber at Chandigarh, Punjab.

The Metric System—Its Origin, Growth and Role in Scientific Advancement

J. K. Varshneya
Non-member

This paper describes the origin and growth of the metric system in the world. It shows the chaotic state of weights and measures in Europe before the French

Revolution, and how it was replaced, under favourable social conditions created by the Revolution, by the metric system of weights and measures—the first rational and logical system of mensuration based on simple, natural, accurately defined and decimal-based units. The paper then surveys the progress of the metric system and its impact on various scientific and technological activities of the society.

Metric Building Products—1

J. K. Varshneya
Non-member

The Standards of Weights and Measurements Act, 1956, lays down a period of 10 years for the complete changeover to the metric system. During the transition period, the building engineers are confronted with a number of problems with regard to the metric dimensions of building products. This article describes the same for the guidance of building engineers.

INSTITUTION NOTICES

Prize for the best article on 'hydraulic similitude' awarded by the Public Charitable Trust for the Advancement of Engineering Education

The Trustees of the Public Charitable Trust for the Advancement of Engineering Education have announced a prize of Rs. 250, donated by Dr. K. L. Rao, Past-President, for the best paper written on the subject of hydraulic similitude by an engineer. Papers are invited now for this prize. Manuscripts should be sent in triplicate under registered cover, superscribed 'Manuscripts for Dr. K. L. Rao's Prize, on the top right-hand corner of the envelope so as to reach not later than **October 31, 1962.** All correspondence in this connection may be addressed to the Public Charitable Trust, Institution of Engineers (India), 8 Gokhale Road, Calcutta 20.

Committee on Floods

The Council at their 420th meeting held in Calcutta on September 9, 1961, decided to appoint a Committee to study the problem of floods in India and to submit a report of their findings, with a view to enable the Institution to suggest the outlines of a national policy to be recommended to the Government of India for the prevention and control of floods, and also authorize the President to constitute the Committee.

Accordingly, the President constituted the Committee with Shri Dildar Husain (*M.*) as Convener, Shri P. R. Ahuja (*M.*), Shri R. D. Dhir (*M.*), Prof. N. S. Govinda Rao (*M.*), Sarvashri C. L. Handa (*M.*), D. V. Joglekar (*M.*), B. P. Kapadia (*M.*), S. Varadaraja Sarma (*M.*), and Dr. H. L. Uppal (*M.*) as members, and Shri S. Sarwal as Secretary to the Committee.

In order to assess the problem in its various aspects, it was desired that the Committee should go into action as soon as possible in order to provide preliminary assessment of the problem and the recommendations of the Committee should be available by the end of June 1962. Accordingly, the first meeting of the Committee was held at Bombay in May 1962, and the second meeting at Calcutta on August 11, 1962, at the Headquarters office. At this second meeting of the Committee, the following observations were made by the Committee.

(i) The importance of flood control in the country is not fully appreciated as the advantages become invisible once the flood control works are executed. As there are no direct returns from those works similar to irrigation and power, due importance is not always given to flood control. This can be judged from the allocation of funds in the budget estimates of the Central and State Governments. The system of providing the flood control funds within the State plans, does not give flood control its rightful place in the developmental activities of the country, unless funds are taken out of the State plans and controlled by the Centre with enhanced funds, if necessary ;

(ii) It is necessary that there should be a regular system for collection of flood data, and ways and means should be found to enlist public cooperation and coordination in recording and tabulating flood information on a countrywide basis. Regular training courses must be introduced for people volunteering or entrusted with collection of flood data ;

(iii) The proforma drawn up recently by the Central Water and Power Commission for collection of flood data is comprehensive, but it should be given much greater publicity. *Panchayat* headquarters, local bodies, district authorities and State Governments should be appraised of the necessity for collection of this information and data. If necessary, suitable assistance should be given to them to ensure uniform and regular collection and compilation of flood data and for forwarding it to a Central authority ;

(iv) In the matter of policy making in the administration of the flood problems, the Committee stressed that the Institution of Engineers (India) should be associated with the administration of flood problems on the technical plane, and the recommendations of this body should cover the general question of planning and organization of flood control in India ;

(v) Irrigation is a State subject and power is a concurrent subject, but flood control is a State subject. It seems necessary, therefore, that it should ultimately become a Central subject, starting as a concurrent subject, at the earliest as possible. The Centre should take over collection of hydrological data in country ; and

(vi) An Indian Hydrological Department similar to the Indian Metrological Department should be established though on much bigger dimensions to ensure that prevention and control of floods have their due place in the country's economy.

Maj.-Gen. Harkirat Singh, President, with members of the Council and members of the Committee on Floods, Institution of Engineers (India), on the occasion of their visit to the Panchet and Kadakvasla Dams in the wake of the disastrous floods in Poona city

Distribution of the *Journal*

The *Journal* distribution (yellow) card attached previously to the *Bulletin* has been generally returned by Corporate Members and Graduates indicating their preference to the Part of the *Journal* they wish to receive. Subsequently, these cards have been issued to individual members also on request. The cards are now also available with the Local Centres, and Corporate Members and Graduates who have not so far returned the card filled in to this office may make use of these. After filling in, the card should be posted to the Headquarters.

Use of facilities at the Local Centres

Members are reminded that when they are on temporary duty or are visiting the area of a Local Centre other than their own, they are welcome to use the library and other facilities at that Local Centre. They are also welcome to attend any meetings which may be arranged by the Local Centre. It is not necessary to be attached to a particular Local Centre for attending meetings, consulting the library, etc.

Where members are permanently transferred from the area of one Local Centre to another, they may, if they wish to do so, contact the office of the new Local Centre as soon as they arrive at their new location in order to be posted of its activities. The routine change of address, when intimated to the Headquarters, will, of course, be made, and the new Local Centre informed by the Headquarters of the transfer. A standard card has been provided in the *Bulletin* dated July 1962 for change of address, and these cards are also available at the Local Centre offices.

Draft Indian Standards

The following draft Indian Standards have been issued recently.

1. Draft Indian Standard Specification for Aluminium Bronze Ingots and Castings for Overhead Fittings in Electric Traction—Doc : SMDC 11(338).

This Standard covers the requirements of aluminium bronze ingots and castings for overhead fittings in electric traction.

Members may send their comments on the above draft Standard before October 16, 1962, to Dr. G. P. Chatterjee (*M*.), Chief Metallurgist, Durgapur Steel Project, P.O. Durgapur Coke Oven, Durgapur, who is the Institution representative on the Sectional Committee dealing with these draft Standards.

2. Draft Revision of Code of Practice for Structural Safety of Buildings : Loading Standards—IS : 875-1957.

This code covers the basic design loads to be assumed in the design of buildings. The imposed loads, including wind loads, which are specified herein are the minimum working loads which should be taken into consideration for the purpose of design. This code does not take into consideration loads incidential to construction and special cases of vibration such as moving machinery, heavy acceleration from cranes, hoists, and the like. Such loads should be dealt with individually in each case.

3. Draft Revision of IS :875-1957 Code of Practice for Structural Safety of Buildings Sectional Committee—BDC 12.

This code covers basic design loads to be assumed in the design of buildings. The imposed loads, including wind loads, which are specified herein are minimum working loads which should be taken into consideration for purposes of design.

This code does not take into consideration load incidental to construction and special cases of vibration, such as moving machinery, heavy acceleration from cranes, hoists, and the like. Such loads shall be dealt with individually in each case.

Members may send their comments on the above draft Standards before October 16, 1962, to Shri H. P. Sinha (*M.*), Consulting Engineer (Road Development), and Joint Secretary, Ministry of Transport, Roads Wing, Jamnagar House, Shahjahan Road, New Delhi, who is the Institution representative on the Sectional Committee dealing with this draft standard.

4. Draft Indian Standard Nomenclature of Floors and Storeys—Doc : BDC 25(640).

This Standard lays down a uniform system for the designation of floors and storeys in buildings.

Members may send their comments on the above draft Standard before October 24, 1962, to Shri Ram Bilas (*A.M.*), Superintending Engineer, Punjab P.W.D., Buildings and Roads Branch, Ambala Circle, 20 Patel Park, Ambala Cantonment, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

5. Draft Indian Standard Recommendations for Modular Coordination Applied to R.C.C. Framed Structures—Doc : BDC 10(564).

This Standard lays down recommendation for preferred dimensions of reinforced concrete structural members like beams, columns, braces, and their relative disposition with a view to achieve modular coordination.

Members may send their comments on the above draft Standard before October 25, 1962, to Shri T. R. Mahendru (*M.*), 14 Asaf Ali Road, Ajmeri Gate Extension, New Delhi, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

6. Draft Indian Standard Specification for Aluminium Bronze Ingots and Castings for Overhead Fittings in Electric Traction—Doc : SMDC 11(338).

This Standard covers the requirements of aluminium bronze ingots and castings for overhead fittings in electric traction.

Members may send their comments to Dr. G. P. Chatterjee (*M.*), Chief Metallurgist, Durgapur Steel Project, P.O. Durgapur Coke Oven, Durgapur, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 2/21 First Line Beach, Madras 1; or 14/69 Civil Lines, Kanpur.

Addresses wanted

The mails of the following members have been returned undelivered. Any member in a position to assist the Headquarters with their present addresses is requested to do so.

Member

M 329 Raj Narain
Raj Bhawan, Clyde Road, Lucknow.

M 939 B. B. Varma
14 Jawaharlal Nehru Road, Tagore Town, Allahabad.

M 1111 D Rajagopalan
Retird Chief Construction Engineer,
Government Electricity Department,
Kasturibanagar, Adyar, Madras 20.

M 1127 S. Guruswami
14 Jagadeeswar Street, T. Nagar, Madras.

M 1202 H. L. Vadera
W2/14 Patelnagar West, New Delhi 12.

M 1435 T. Seshagiri Rao
Flat 403. 4th Floor, 'Prabhu Kunj,' Junction of Pedder Road and Behramji Gamadia Road, Bombay 26.

M 2069 Martand Vinayak Joshi
Member, Railway Service Commission, Churchgate, Bombay 1.

Associate Member

AM 1510 V. S. Ratnam
13 Gandhi Road, Salem, Madras.

AM 2283/L V. W. Gothoskar
Superintending Engineer, Gujarat Construction Circle, New Civil Hospital, O.P.D. Block, Asarwa, Ahmedabad 11, Gujarat.

AM 3002 Chander Sain
Assistant Garrison Engineer (Naval Works), Vithal House, Mint Road, Fort, Bombay 1.

AM 3081 Narayan G. Godbole
9B/20 Sector X, Bhilai, Madhya Pradesh.

AM 3913 R. N. Mukherjee
106/D/I Diplomatic Enclave, Chanakyapuri, New Delhi.

AM 4456 B. Venkatachalam
Executive Engineer (Public Health), National Rural Water Supply and Sanitation Scheme Division, Kurnool, Andhra Pradesh.

AM 5672 Bhagwat P. Sharma
P.O. Kalyani, District Nadia.

AM 6007 Girindra K. Chakravarty
2A/47 Sector 10, P.O. Bhilai Steel Plant, District Durg, Madha Pradesh.

AM 6138 S. K. Chaudhuri
Choca Canning & Mining Ltd., Post Box No. 95, Nagpur.

AM 6187 Ramchandra C. Kale
Next to Laxminarayan Baug, Bal Govind Das Road, Mahim, Bombay 16.

AM 6597 M. N. Mathur
Executive Engineer (Designs), P.W.D., Kohima, N.H.T.A.

AM 6776 Terry John Varkie
'Kailas', Peddar Road, Bombay 26.

AM 6789 Gopal Dass Arora
30 River View Road, Nangal Township, Punjab.

AM 6854 M. R. Warrier
Mechanical Engineer, Binny's Engineering Works, Meenambakkam, Madras 27.

AM 8351 Capt. Harbans Singh Gill
S.O.3 Technical Planning, Director General Border Roads, Kashmir House, New Delhi.

AM 8805 M. P. Gowande
C-1C/1 Pophali Colony, P.O. Pophali, District Ratnagiri, Maharashtra.

AM 9133 Capt. R. S. Bhatia
Institute of Armament Studies, Kirkee, Poona 3.

AM 9137 R. Govind Joshi
Structural Steelwork Designer, c/o Richardson & Cruddas Ltd., Byculla, Bombay 8.

AM 9140 M. F. Mendes
Structural Steel Designer, c/o Richardson & Cruddas Ltd., Byculla, Bombay 8.

AM 9380 R. B. Patel
4 Sunset Avenue, Chittaranjan, West Bengal.

AM 9427 Yagya Dutt Misra
House of Brig. N. S. Rawat, Bhotio Parao, Haldwani, District Nainital, U.P.

AM 9559 Ram Krishna Banerjee
Assistant Executive Engineer (C), Quarter No. III, Type 3, Sector B, Piplani, Bhopal, Madhya Pradesh.

AM 9734 Capt. C. Prakash
Electrical & Mechanical Engineers' School, P.O. Trimulgherry, Secunderabad 15, Andhra Pradesh.

AM 9794 A. K. Dhol
Birla Institute of Technology, P.O. Mesra, Ranchi, Bihar.

AM 10070 V. G. Dias
Office of the Executive Engineer (S/F), Chittaranjan Locomotive Works, P.O. Chittaranjan, District Burdwan, West Bengal.

Graduate

G 324 Shanti Swarup Goyal
S.D.O. (W & B), Panisagar, Tripura.

G 742 N. Rajagopalan
17C Street 2, Sector II, Bhilai 1, Durg, Madhya Pradesh.

FORTHCOMING CONFERENCES

Symposia on (i) 'Sewage Treatment', and (ii) 'Education of Public Health Engineers', Nagpur, December 1962

Under the auspices of the Nagpur Centre of the Institution and the Central Public Health Engineering Research Institute, Nagpur, symposia on (i) 'Sewage Treatment', and (ii) 'Education of Public Health Engineers' will be held in December 1962.

The symposium on 'Education of Public Health Engineers' is being held with a view to evolving a uniform syllabus for graduate and post-graduate instruction in public health engineering. It will also afford an opportunity to professors of public health engineering and practising engineers to discuss problems of mutual interest.

Members who are desirous of presenting papers at the Symposia may send two copies of the abstract of the paper which should not exceed more than 300 words by September 15, 1962, to Dr. N. U. Rao, Central Public Health Engineering Research Institute, 70/1 Civil Lines, Nagpur. Full text of the paper should be handed over at the time of presenting the paper.

Symposium on 'Recent Developments in Iron and Steelmaking with Special Reference to Indian Conditions', Jamshedpur, February 4-8, 1963

A Symposium on 'Recent Developments in Iron and Steelmaking with Special Reference to Indian Conditions', sponsored jointly by the Indian Institute of Metals, National Metallurgical Laboratory, and Iron and Steel Institute, England, will be held at Jamshedpur from February 4-8, 1963. The Symposium will present a forum wherein metallurgists, research scientists, technologists and consumers can exchange technical knowhow and views on latest developments in iron and steelmaking with particular reference to their applications under Indian conditions. During the Symposium, an integrated pilot plant for mineral beneficiation of low grade Indian ores set up by the National Metallurgical Laboratory at a cost of Rs. 5 million will also be inaugurated. Visits to the National Metallurgical Laboratory, Tata Iron & Steel Works and other industrial establishments at Jamshedpur will also be arranged.

Further particulars regarding the Symposium can be had from the Director, National Metallurgical Laboratory, Jamshedpur 7.

First Asian Conference in Hydraulics and Hydraulic Machines, Bangalore, May 1963

The First Asian Conference in Hydraulics and Hydraulic Machines will be held at the Indian Institute of Science, Bangalore in the second week of May 1963. The subjects to be discussed will include :

(i) Flow in open channels and conduits ;
(ii) Air entrainment in flows ;
(iii) Cavitation ;
(iv) Hydraulic turbines and pumps ; and
(v) Instrumentation in hydraulic measurements.

Further details regarding the Conference can be had from Prof. K. Seetharamiah, (*M.*) Convener, Civil and Hydraulic Engineering, Indian Institute of Science, Bangalore 12.

Joint International Conference on Creep, New York, August 25-28, 1963 ; and London, September 30-October 4, 1963

A Joint International Conference on Creep will be held in New York from August 25-28, 1963, and in London from September 30-October 4, 1963, under the auspices of the American Society of Mechanical Engineers, The Institution of Mechanical Engineers, London, and the American Society for Testing Materials.

The Conference will deal with mechanical properties of engineering materials at elevated temperatures and the utilization of creep and rupture data on current materials in the design of equipment to be used at elevated temperatures.

Members desirous of presenting papers at the Conference should send a synopsis of the paper not exceeding 250 words to The Secretary, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster London, S.W. 1, from whom further details can be had.

BOOK ACKNOWLEDGMENTS

1. **A Text-Book of Sanitary Engineering.** G. B. Kanuga. *Khanna Publishers*, Delhi, Rs. 9. 334 pages.

This book covers fundamentals of sanitary engineering with special reference to sanitation problems of India.

2. **The Fundamental Principles of Irrigation Engineering.** V. B. Priyani. *Charotar Bookstall*, Anand, Rs. 15.00. 474 pages.

This book, written essentially for the student, covers in brief the designs used and the methods followed in the irrigation systems in India, in addition to the basic principles of irrigation engineering.

3. **Practical Problems in Soil Mechanics.** H. R. Reynolds and P. Protopapadakis. *B. I. Publications*, Bombay, 3rd edition. 224 pages.

The essential features of soil mechanics studies have been collated and crystallized, omitting mathematics as much as possible and avoiding analytical approach to the solution of problems. It is anticipated that the book will make an appeal to the civil engineers in practice and students studying for examinations.

4. **Urban Survival and Traffic.** Edited by T. E. H. Williams. *E. and F. N. Spon Ltd.*, 60 s. 257 pages.

The aim of this symposium volume is to present the professional problems encountered in urban redevelopment, with particular reference to motor traffic, and describe some of the modern solutions to these problems. The presentation is directed to professional civil engineers, highway and traffic engineers, architects, town planners, and officers of Central and Local Governments who are concerned with urban problems and redevelopment.

5. **Design and Development of Electronic Instruments.** S. S. Banerji. *Asia Publishing House*, Bombay, Rs. 2. 26 pages.

This monograph deals briefly on some very general topics like design and development of electronic instruments, simple ionospheric equipments, electronic wattmeter, etc. Those engaged in research in similar fields of endeavour are expected to benefit from this.

6. **Elementary Differential Equations.** N. Vencoba Row. Published by the author, 25 Basappa Lay-out, Gavipuram Extension, Bangalore 19, Rs. 4. 151 pages.

This is an elementary text-book designed for technical students. Examples are given, supplied with answers.

7. **Appplied Chemistry for Engineers.** E. S. Gyngell. *B. I. Publications*, Bombay, 3rd edition. Rs. 18.50. 359 pages.

The third edition of this well known book has been thoroughly revised. In view of the very rapid development in the field of nuclear engineering projects all over the world, new chapters have been added to include nuclear fuels and nuclear reactors. Sections dealing with fuels and combustion, gasification of solid fuels with oxygen, the production of town gas from petroleum oils, and the separation of close-cut fractions from natural and cracker gas have also been expanded for the same reason. Chapters on corrosion, paints and varnishes, water treatment and sewage disposal, cement, and lubrication have also been revised to accommodate the present day theories and practices.

PUBLICATIONS RECEIVED

The following publication has been received from the Presses Academiques Europeennes, Brussels: 'International Bibliography of Automatic Control': the first issue of this new international journal, publishing titles of papers and books from countries all over the world, contains 936 classified entries giving titles in English and French, with indication of the original language and the usual bibliographical references; and an author index, a list of periodical bibliographical sources, and a list of non-periodical bibliographical sources.

A publication entitled 'Composite Construction for Steel Framed Buildings' has been received from the British Constructional Steelwork Association, London. The object of this brochure is to present for the assistance of the designer the properties of the additional range of sections acting compositely with the concrete deck. Many of the steel framed buildings will be provided with fire-resisting floors of reinforced concrete and the use of the floors and steel beams in composite construction, wherein all or most of the compression due to bending is taken by the floor slabs and the tension by the steel beams, will result in considerable reductions in the weight of steel used for beams.

The following publications have been received from the Central Water and Power Research Station, Poona: (i) 'Peak Flow Estimation by Method of Maximum Likelihood' by G. M. Panchang and V. P. Aggarwal. A schematized method of speedily and systematically sieving through the complicated computations for arriving at the estimation for the average peak flow magnitude of different return periods is presented; and (ii) 'Spillways and Energy Dissipators—Hydraulic Model Investigations' by M. G.

Hiranandani and G. T. Wadekar. In this brief memorandum, a few model investigations of medium head spillways and stilling devices are explained, to indicate results diverging from the current empirical laws and tentative design rules so as to highlight their unconventional design features.

The following publications have been received from the National Buildings Organization, New Delhi: (i) 'Report on Study of Methods Used for Waterproofing of Roofs in India', and (ii) 'Rural Housing and Village Planning'.

Two copies of the publication entitled 'Life and Works of Nawab Ali Nawaz Jung Bahadur' by Misbahuddin, published by Apex Books Concern, Hyderabad, have been received from the author. This publication includes a life sketch of Nawab Ali Nawaz Jung Bahadur and details of the projects with which he was connected.

LIST OF NEW ELECTIONS AND TRANSFERS

(Continued from Bulletin for July 1962)

MEMBERS

No.	Name	No.	Name
2593	Cdr. Krishna Kumar Batta*	2599	T. Ananthaswamy Rao
2594	Ved Prakash Dusaj*	2600	Narain Bhavanani*
2595	Brig. Maridu Ayyanna Nayudu*	2601	Sailes Chandra Ghose
2596	Prof. Nagella Sidheswar*	2602	Prof. Devaguptapu Seethapathirao
2597	Narayanarao Rama Rao*	2603	Joginder Pal Bajaj
2598	Chelamkoori Subba Rao*	2604	Raghvendra Shankar Basrur

ASSOCIATE MEMBERS

No.	Name	No.	Name
10251	Ramchand Purswani	10268	Rajaram Shridhar Bari
10252	Sharadkumar Manjunath Vaknalli	10269	Capt. Gour Kishore Roy
10253	Capt. Shiv Kumar Sahni	10270	Rangarathnasastri Venkataratnam‡
10254	Askaran Naraindas Bhatia	10271	Virupax Veerappa Saunshi
10255	Gunvantray Nanubhai Desai	10272	Narendra Rasiklal Desai
10256	Mulk Raj Madan	10273	Ajjampur Ananthaswamy Rao
10257	Capt. Surinder Sarup	10274	Capt. Lakshmi Pati Sharma
10258	Ramcharan Lal Saksena	10275	Ramchandra Narayan Mungale
10259	Francis Cajetan Pontes	10276	Prithi Pal Singh Basur
10260	Yashwant Rai Agrawal	10277	Pratap Sitarama Sastri
10261	Triveni Prasad Sharma	10278	Narayanan Vasudevan‡
10262	Shamrao Ganesh Laud	10279	Rashmi Kalidas Mehta
10263	Capt. Gundappa Gopal	10280	2/Lt. Munuswamy Swaminadhan
10264	Capt. Krishnannair Kumaran	10281	Shivo Narayan
10265	Moreshwar Govindrao Vaidya	10282	Srinivasan Santanagopalam
10266	Flt. Lt. Janki Nath Sachdeva†	10283	Nangamangalam Chetlur Chakravarthy
10267	Mahabir Prasad Sharma	10284	Capt. Joginder Pall Singh Sahi

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* Transferred from Associate Member.

‡ Transferred from Graduate

† Transferred from Student.

ASSOCIATE MEMBERS (*contd.*)

No.	Name	No.	Name
10285	Nagavalli Venkatesham	10302	Seevalaperi Muthuswamy Subramanian
10286	Prabhakar Ramchandra Patankar	10303	Kompella Venkata Subrahmanya Seshagiri Rao‡
10287	Pallasena Krishnaiyer Subramaniam	10304	Shitala Sharan
10288	Madhusudan Ishverbhai Patel	10305	A. Krishnasastry Sreenivasa Murthy
10289	Baikuntha Nath Dash	10306	Santosh Kumar Sharma
10290	Vaman Vasudeo Dharmadhikari	10307	Srinivas Ramanath Shanbhag
10291	Narayanarao Nagaraja	10308	Prabhakar Shripad Vaidya
10292	Yelwal Venkatachar Seetharam Iyengar	10309	Hariharaiyer Padmanabhan
10293	Maj. Girish Behari Lal	10310	Ramaswamy Natarajan
10294	Capt. Avinash Chandra Mohan	10311	Capt. Indra Jit Puri
10295	Capt. Daljit Singh	10312	Krishan Sarup Chopra
10296	Madhav Vinayak Shrotriya	10313	Chomacheri Raghavan Nair
10297	Vithaldas Khushaldas Chavada	10314	Tushar Kanti Ghosh
10298	Prabhakar Shridhar Pandit	10315	C. Vasambhatta Suryanarayana Sastry
10299	Basettihalli Krishnamurthyrao Raghavendra Rao	10316	Rajendra Nath
10300	Flt.-Lt. Kailash Chander Kapoor	10317	Kavungal Gangadhara Menon‡
10301	Narasingarao Hiranya	10318	Capt. Ramesh Kumar Malhotra

GRADUATES

No.	Name	No.	Name
1502	Hota Sitarama Sastry	1522	Rajagopalan Krishnamurthy†
1503	Nittoor Seetharamiah Sathyanarayana†	1523	Mrugendra Madhao Thomare
1504	Palghat Krishnier Sankaranarayanan Iyer	1524	M. Achuthan
1505	Plt.-Offr. Ramanarayanan Parameswaran	1525	Jehangir Phiroze Patel
1506	M. Ranganathan Vijayaraghavan†	1526	Satish Chandra Jauhar
1507	Gajkumar Jioraj Kothadia	1527	Mukunda Bhusan Guha†
1508	Badri Narain Srivastava†	1528	Nimai Chandra Saha†
1509	Gurbachan Singh Bhatia	1529	Chhail Chandra Yadava†
1510	Vattamanna Pariyarath Achuthan†	1530	Janagam Atcheswar Rao†
1511	Anant Vishnu Samudra	1531	Vijay Laxman Pitke†
1512	Esainur Venkatesan Venugopal	1532	Kunnath Ravindranath
1513	Anantha Krishna Iyer†	1533	Ravindra Kumar Gupta†
1514	Joginder Singh Sadh†	1534	Ashit Kumar Mitra†
1515	Jalaluddin	1535	Raj Kishore Agarwa
1516	Taher Bhai Daud	1536	Kandaswamy Sadasivan
1517	Sudhir Vasant Datar	1537	Rajendra Kumar Tandon
1518	Dwarakanath Balkrishna Kamalapurkar†	1538	Narayan Chintaman Khadilkar
1519	Qazi Ashfaq Ahmed	1539	Harish Chandra Chandulal Patel
1520	Hridaya Narain Lal	1540	Ishwar Sharan Pandey†
1521	T. Krishnamoorthy Subramanian	1541	Govindan Venugopal†

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‡ Transferred from Graduate.

† Transferred from Student.

STUDENTS

No.	Name
32210	Konanki Ramaswamy
32211	Sunil Kumar Sen Gupta
32212	Akhilesh Kumar Verma
32213	Bimalendu Sarkar
32214	Nirmal-Kanti Kar
32215	Chittaranjan Sarangi
32216	Garimella Venkata Ramana Rao
32217	Shiv Swarup Yadav
32218	Bhola Nath Khanna
32219	Dharm Singh
32220	Sangaram Sreenath
32221	Karra Venkata Ramanamurty
32222	Arnepalli Kanakayya
32223	Thottathu Kesavan Asokan
32224	Ramanugrah Lal
32225	Balasaheb Ramgonda Patil
32226	Potturi Venkata Chandra Mouli
32227	Trichur Subramaniam Krishnan
32228	Chittaranjan Jana
32229	Lakshmi Narayan De
32230	Patnala Satyananda Rao
32231	Vishwa Kant
32232	Bharat Bhooshan
32233	Promod Kumar Sahgal
32234	Mahmood Ghori
32235	M. Anwar
32236	Hari Chand Agrawal
32237	Kaza Eswara Rao
32238	Rajendra Kumar
32239	Gour Kishore Paul
32240	Sharatchandra Nivriti Rokade
32241	Kumundur Varadarajaiyengar Lakshminarasimha Iyengar
32242	Muhammad Habib
32243	Arabinda Chattopadhyay
32244	Priyaranjan Mitra
32245	Sudhir Chandra Sabharwal
32246	Tarsem Chand Aggarwal
32247	Saktipada Das
32248	Pankaj Kumar Das
32249	Sadanand Parshuram Prabhu
32250	Karumuri Suryaprakasa Rao
32251	Ishwar Singh Thakran
32252	Grish Mohan Gupta
32253	Ram Autar Vaish
32254	Vishwa Mitra Ojha
32255	Janardan Vasant Kamat
32256	Krishna Narayan Karandikar
32257	Chamarajanagar Naranappa Bhaskara
32258	M. S. Srinivas
32259	Samir Kumar Roy
32260	Manohar Laxmanrao Hudke
32261	Ramji Lal Shukla
32262	Bimal Kanti Das
32263	Om Prakash Govil
32264	Birjendra Kumar Srivastava
32265	Rajeshwar Sain Chawla
32266	Subramani Narayana Murthy
32267	Narendra Nath Gulati
32268	Gajjan Singh Ahluwalia
32269	Ramaraopooram Vijendra Rao
32270	Maganlal Lallubhai Mistry
32271	Raj Kanwar
32272	Purujit Mitra
32273	Vishnu Prakash Sharma
32274	Amarjit Singh Vijan
32275	Debashis Chatterjee
32276	Asit Kumar De
32277	K. Rajagopalan
32278	Tapan Kumar Ghosh
32279	Barendra Narayan Goswami
32280	Deb Ranjan Dutta
32281	Sudhir Kumar Basak
32282	Syam Lal Sarkar
32283	Sambhu Nath Ghanta
32284	Sitangshu Pada Mustafi
32285	Surinder Singh Philloura
32286	Bhagwan Singh
32287	Swayambhu Bhattacharya
32288	Shyam Singh
32289	N. R Balasubramanian
32290	Shreepati Singh Yadav
32291	Harkesh Singh Teotia
32292	Martand Dwarkanath Chitnis
32293	Madhukar Ramchandra Benait
32294	Chettanile Mathai Kurian
32295	Shreekant Shankar Patil
32296	Trimbak Dajiba Kuhade
32297	Baboo Lal Sharma
32298	Madan Mohan Lal Chhibba
32299	Bansi Lal Chugh
32300	K. Chandrasekariah

STUDENTS (*contd.*)

No.	Name
32301	Taremela Lakshmanachar
32302	A. P. Puttananja Raj Urs
32303	Bethamangala Raghunatha Rao
32304	Rayappa Narayan Raikar
32305	S. Ramakrishna
32306	Jai Bhagwan
32307	Hari Chand Gupta
32308	Rajendra Singh Sirohi
32309	Shanti Narayan
32310	Bal Mukund Singh
32311	Krishna Kumar Agarwal
32312	Ram Kishore Gupta
32313	Srinivasan Venkataraman.
32314	Mahendra Singh
32315	Manikchand Deomansa Kanhed
32316	Eric Joachim D'Sa
32317	Arvind Gopal Shere
32318	Sarwan Singh Badal
32319	Narotam Kumar Narula
32320	Soundararajan Krishnan
32321	Bhagwan Chate
32322	Prabhakar Ganesh Beke
32323	Malur Raghavendrarao Sathyanarayana Rao
32324	Biman Kumar Ghosal
32325	Kaushal Kumar Agarwal
32326	Anant Narayanrao Ingle
32327	Obli Sunder
32328	Nand Kishore Goel
32329	Ravindra Raghava
32330	Alfred James Karunakaran Phillips
32331	Kamalakar Deorao Indane
32332	Guru Bachan Arora
32333	Santosh Kumar Dwivedi
32334	Sohan Lal
32335	V. Sankararamasubramaniam
32336	Shailendra Kumar Sikroria
32337	Gopeswar Mandal
32338	Prakash Chand Gupta
32339	Dipak Kumar Roy Chowdhury
32340	B. M. Thippeswamy
32341	C. Umashankar
32342	Hariharapuram Rangachar Srinivasan
32343	Kadadakatte Basappa Somasekharappa
32344	Thogarighatta Narasingarao Narasimha Murthy
32345	T. Dyamanna
32346	G. A. Dayanidhi
32347	Syed Abdul Rasheed
32348	Sree Rama Reddy
32349	Hosallappa Shivarudraiah
32350	M. L. Sathyendra
32351	B. S. Sundarappa
32352	R. K. Anantha Raman
32353	A. Narasimha Murthy
32354	Harbans Lal Kakar
32355	Surendra Kumar Sharma
32356	Daya Nand Sharma
32357	Magadi Rudrappa Visveswaraiah
32358	Shankarlal Chandiram Tewani
32359	P. Chellappan Pillai
32360	Chandulal Ramchand Bhatia
32361	A. K. John
32362	Muniswamappa Ananda
32363	Surendra Singh Negi
32364	Chamarajanagar Subramanyasastry Satyanarayana Sastry
32365	Ramesh Chander Chandwani
32366	Balkrishna Venkatrao Chetty
32367	Benoy Krishna Dhar
32368	Vasant Govind Patil
32369	Devidas Motiram Ramekar
32370	Devendra Kumar
32371	M. Girinath
32372	Shashikant Dattatraya Jog
32373	Subhas Vamanrao Samant
32374	Satya Paul Duggal
32375	Suresh Vinayak Kulkarni
32376	V. Ashwath Rao
32377	Belur Rangaswamy Keshava Murthy
32378	Bangalore Narasingappa Satyanarayana
32379	S. Vasudeva Rao
32380	Subhash Chandra
32381	Dalip Singh
32382	K. Ramachandran
32383	Dev Raj
32384	Hardeep Singh Bhogal
32385	Brij Mohan Aggarwal
32386	Brajendra Singh Chauhan
32387	Pran Nath Basra
32388	Ferdinand Joseph Melo Furtado
32389	Narendra Kumar Gupta

STUDENTS (*contd.*)

No.	Name
32390	Arvind Vasant Chaubal
32391	Tapas Kumar Sarkar
32392	Swadesh Kumar Kapur
32393	Kumsi Nadig Gopinath
32394	Chandrakant Baburao Merulingkar
32395	Surendra Kumar Mehta
32396	Raghavendra Ramarao Parvatikar
32397	Chandrasen Kamlakant Dhotre
32398	Deo Datt Mudgal
32399	Shriram Krishna Namivadekar
32400	Shabda Kumar Roy
32401	Vodyanea Devendra Salian
32402	Bhup Singh Malik
32403	Nandan Swaroop Garg
32404	Jayant Ganesh Gogate
32405	V. Chakrapani
32406	Jagdish Singh Dogra
32407	Shive Kumar Purohit
32408	Celestino Rozario Fernandes
32409	Vasant Gangadharrao Khond
32410	Mohamed Azam
32411	Manohar Janardhan Gokhale
32412	Balapuram Manickam Subramaniam
32413	Kamal Nath Mehra
32414	Jai Kumar Jain
32415	Suresh Gajanan Potnis
32416	Nilkanth Wasudeorao Deshpande
32417	Shri Chand Gupta
32418	Kundan Lall Uppal
32419	Hallimysore Narasimaiah Lakshmikanthaiah
32420	Raj Bahadur Singh
32421	Kantilal Bhogilal Shah
32422	Ganpat Vithalrao Singtamkar
32423	Kamlesh Tolani
32424	Madhukar Venkatrao Deshpande
32425	Pritamkumar Gangaram Mandan
32426	Mahabir Bahadur Mathur
32427	S. Narasimhan
32428	Shridhar Ganpat Mahajan
32429	Krishna Deo Choudhary
32430	Ratnakar Martand Tandalaskar
32431	Jitendraprakash Somprakash Bhatnagar
32432	T. V. Govinda Rao
32433	Krishnaswamy Venkata Subramanian
32434	Dhan Raj Paul Sharma
32435	Govind Vithal Nori
32436	P. V. Subramaniam
32437	K. Ravindranath Pai
32438	Jyotindra Manohar Trasi
32439	Kamala Kant Singh
32440	Harihar Prasad
32441	Dibyendu Sekhar Ghose
32442	V. Raghuvaran Nair
32443	Chandrashekhar Vaman Devasthale
32444	Inder Kumar Chhabra
32445	Mukund Vithalrao Mulay
32446	Bachan Singh
32447	Yaraguntappa Thippeswamy
32448	Kiran Kumar Chaurasia
32449	Sheo Muni Patel
32450	Rajagopalachary Thirumalai
32451	Bishambhar Swaroop
32452	Hira Lal Gupta
32453	Siyaram Sharan Sharma
32454	Surya Narayan Sinha
32455	Sunil Kumar Ghosh
32456	Awadh Narain Sinha
32457	Jagadish Chandra Dey
32458	Chakravarthy Ramanujaiyengar Raju
32459	Mohammad Quasim
32460	Manas Mohan Mukherjee
32461	G. A. Lakshminarayana Setty
32462	Shatrughna Singh
32463	Bharat Bhushan Singh
32464	Velamala Lakshmana Rao
32465	Ardaman Singh Saini
32466	Santan Singh Negi
32467	Pandurang Swamiracharya Avadhani
32468	Prem Singh
32469	Arya Kumar Aiyar
32470	Surinder Kumar Chopra
32471	Joseph Francis D'assisi Desa
32472	Jaywant Sadashiv Khandekar
32473	Ravindra Trimbak Sinnarkar
32474	Laxmichand Valabdas Udeshi
32475	Dodbele Narayanarao Lakshmi Narayana
32476	Ram Shanker Vashistha
32477	Vijay Vishnupant Sangwai
32478	Mittar Bhushan Nayyar
32479	Rameshchandra Shridhar Agrawal
32480	Hiranand C. Matai
32481	Sukumar Roy

STUDENTS (*contd.*)

No.	Name	No.	Name
32482	Rabindra Chandra Pant	32528	Santosh Kumar Mukherji
32483	Ram Kanwar Goel	32529	Mohamedhusain Mohamedhanief Karwar
32484	Maida Ram	32530	Ajit Kumar Mukherjee
32485	Krishnaji Narayanrao Malghan	32531	Sreedhara Veeranjaneyulu
32486	Romesh Chandra Bhardwaj	32532	Gurumoorthy Chandra Sekaran
32487	Satish Chander Girotra	32533	Madan Parkash Pilani
32488	Vinodkumar Shrikrushnarao Hardas	32534	Sukhendra Nath Chakraborty
32489	Musthafa Syed Zakaullah	32535	Kamta Prasad Sah
32490	Hassan Srikantaiah Gopalakrishna	32536	Bishnu Charan Banerjee
32491	P. Balakrishnan Nair	32537	Sailesh Ranjan Das
32492	Mohammadyusuf Mohiddinsaheb Ramali	32538	Narayan Chandra Bhadra
32493	Mukundray Trambaklal Sompura	32539	Manickam Kanakasabesan
32494	V. Puttalingaiah	32540	Virendar Nath Sharma
32495	Nilambar Hazarika	32541	Pamujula Sreeramulu
32496	Sujit Kumar Rudra	32542	Prabir Kumar Paul
32497	Jagdish Rai Dewan	32543	Mange Ram Gupta
32498	Gopala Kesava Iyer	32544	Jagdish Raj Kohli
32499	Autar Singh	32545	Bhupinder Bir Singh
32500	Mohan Lal	32546	Vidya Parkash Chawla
32501	Shahenshah Nawab	32547	Ramesh Chander
32502	Narasimhaiah Jairama Reddy	32548	Brij Bhushan Sharan Agarwal
32503	Medigesi Krishnamachar Rajagopal	32549	Vasantrao Annarao Mulay
32504	Balbir Singh Saini	32550	Anandur Keshavamurthy Balasubramanya
32505	Lakshmanasandra Gundappa Gururaja Rao	32551	Pradipta Bhaskar Sinha
32506	Satya Narain Bharadwaj	32552	Suresh Dipchand Shah
32507	Krishnaswamy Venkataram	32553	Nawal Kumar Sinha
32508	Mahesh Chander Vasudev	32554	Satish Kumar Kapoor
32509	Seetharama Bhatta	32555	Anil Kumar Datta
32510	Parimal Chandra Taran	32556	Parasuram Parameswaran
32511	Ranjit Rai Bhaskar	32557	M. Varijakshan
32512	Chandravadan Joitaram Suthar	32558	Yalamanchili Ramamohana Rao
32513	Surjit Kumar Bhasi	32559	Sushil Chandra Saha
32514	Laxman Yamunasa Miskin	32560	Kamal Krishna Dandapat
32515	Kailash Chandra Purohit	32561	Kondaka Ramulu
32516	Madhusudan Bhowmik	32562	Ramasubramanian Sankaran
32517	Mohindar Pal Bansal	32563	R. S. Annaswamy
32518	Gurbachan Singh	32564	Peddibhotla Venkata Suryanarayana
32519	Chennupaty Krishnamurthy	32565	Naresh Chandra Mitra
32520	Surinder Mohan Kapoor	32566	Vyankatesh Krishnaji Potdar
32521	Debadas Maitra	32567	Cherukat Janardhanan
32522	Tennety Venkata Ramana Rao	32568	Sewaran Singh Gahla
32523	Varada Satyanarayana	32569	Jaswant Singh Grover
32524	Gokaran Nath Tewari	32570	Krishnaswamy Thukaram
32525	Syed Mohammad Umar	32571	Raghunath Shambhurao Nargundkar
32526	Sankarasastry Ramasubramanian	32572	Rajarama Venkatakrishnan
32527	Ajit Kumar Mondal	32573	Dilip Kumar Chakraborti

STUDENTS (*contd.*)

No.	Name
32574	Srikumar Sen
32575	Krittika Ranjan Barua
32576	Pramit Kumar Bose
32577	D. Narayanrao Ranga Rao
32578	Antony Joe Francis
32579	Ratneswar Konwar
32580	Dhavureddiar Balaraman
32581	Aravind Narahar Sakhavalkar
32582	Tapas Kumar Sanyal
32583	Parimal Chandra Das
32584	Pushpendu Sekhar Ghoshal
32585	Durgashankar Halder
32586	Umashankar Ghose
32587	Debendra Nath Santra
32588	Kalipada Bala
32589	Yennbari Joshua Jayakumar
32590	Chadaram Thatha Rao
32591	Jagannath Lal
32592	Susil Kumar Basu
32593	Jayanta Kumar Sarkar
32594	Susanta Sarkar
32595	Rajagopalan Venkataraman
32596	Nemmini Divakaran
32597	Krishnaayyer Narayanan
32598	Peddu Venugopalan Venkatanagarathnam
32599	Puthamkurichi Mayuranathan Krishnamoorthy
32600	Muthuvenkatapathy Srinivasan
32601	Padinjarematom Veeraraghavan Narayanan
32602	Nilakantan Sankaran
32603	Narasimhan Srinivasan
32604	Manikkiri Viswanathan
32605	Venkateswaran Krishnamurthy
32606	Thimiri Munuswami Subramanian
32607	Aulia Saudagar Noor Ahmed
32608	Poollachi Narasimhan Narayanan
32609	K. N. Natarajan
32610	G. S. Subramanian
32611	Amal Kumar Ghosh
32612	S. Ramamoorthy
32613	Nagappa Gadgeppa Gobburu
32614	Kashinath Vithal Pawar
32615	A. V. Rangarajan
32616	Ram Prakash Sharma
32617	Sushanta Kumar Mishra
32618	Laxman Krishnaji Kekhalekar
32619	Rajender Pal Sharma
32620	Tushar Kanti Chakravarty
32621	Chandra Madhab Sen
32622	Dilip Kumar Sil
32623	Kamala Kumar Sen Gupta
32624	Chandra Prakash
32625	Krishnapada Roy
32626	Bithaldas Mundhra
32627	Somesh Chandra Bose
32628	Santi Kumar Ganguly
32629	Shew Kumar Bajoria
32630	Mukaparthi Ramakrishna
32631	Shashikumar Surendra Daddi
32632	S. Ebenezer Robert
32633	Santasil Bandhu
32634	Sankaranarayanan Gopalan
32635	J. Muthurathnam
32636	J. Ignatius
32637	K. Gopal Bhat
32638	Vasu Shanmugha Das
32639	Madhav Prasad Gupta
32640	Ashish Kumar Mittra
32641	Mohamed Ismail Sait
32642	Hem Chandra Das
32643	Shriram Bhaskar Javdekar
32644	Sudhir Kumar Ghosh
32645	Kashinath Kundu
32646	P. C. Mathew
32647	Buddiga Koteswara Rao
32648	Bantwal Vasudeva Somayaji
32649	Kadavathrail Geevarughese John
32650	Nikhiles Maiti
32651	Suttamally Sankaranarayanan Narayanan
32652	Ram Narayan Roy
32653	Kamal Kumar Gain
32654	Moti Jotumal Lulla
32655	Gopalasamudram Sankarasubramaniaiyer Sivaswami
32656	Madhav Yeshawant Begul
32657	Sukumar Chaudhury
32658	Valkadai Duraiswamyiyer Ravikumar
32659	E. Srinivasan
32660	Kesavan Viswambharan
32661	Srinivasamurthy Padmanabhan
32662	Seetharaman Krishnasubramanian
32663	Gopalsamy Vasudevan

STUDENTS (*contd.*)

No.	Name
32664	Devalla Radha Krishna Reddy
32665	Valangaiman Srinivasavarada Narasimhan
32666	Subramanya Kalyanasundaram
32667	R. Gurumurthy
32668	Nagabhyru Rama Rao
32669	Challagulla Nageswara Rao
32670	S. Balakrishnan
32671	Kuppuswamy Makarabushanam
32672	Javvaji Venkateswara Rao
32673	Natarajan Ramamurthy
32674	Munisamygounder Nanjundan
32675	K. S. Kulasekaran
32676	A. Subramanian
32677	Kovoor Mathew Mathew
32678	S. Lakshminarasimhan
32679	Sivathanu Esakimuthu
32680	Krishnamaraja Ramachandran
32681	Basant Kumar Jain
32682	Mohammed Abdul Khayum
32683	Charan Singh
32684	M. Venkataratnam
32685	Khialdas Sachanand Ochani
32686	Bishnu Charan Basu
32687	V. Subramanian
32688	P. Chithambara Thevar
32689	S. Ramaswami
32690	Palvannathever Ramalingam
32691	Digambar Raghunath Deshpande
32692	Vishnampet Venkataraman Viswanathan
32693	Ashok Vasudeo Jahagirdar
32694	Keshaw Sitaldas Vanvari
32695	Chinnabhandhara Krishnamoorthirao Sreedhara
32696	Arvind Narhar Joshi
32697	Subir Chandra Sengupta
32698	Anand Rao Hindwani
32699	Janardan Krishna Jadhav
32700	U. N. Subhas Chandra Uttarkar
32701	Kuttappan Bhakthan Vatsalan
32702	Dandu Suryanarayana Raju
32703	D. Aswarthanarayana Reddy
32704	T. R. Kothanda Raman
32705	Shah Nawaz Husain
32706	Dilip Kumar Roy
32707	Salil Kumar Dutta
32708	Bishwa Nath Singh
32709	Sib Sankar Mazumder
32710	Asok Sengupta
32711	Ramesh Pratap Malik
32712	Rajendra Kumar
32713	Jayanta Kumar Mazumder
32714	Viravajjula Anantham
32715	Gangeyula Venkata Subba Rao
32716	Harcharan Dass
32717	Kondiparthi Sathyanarayana
32718	Lakshapathy Venkatesan
32719	Geddam John Sudhakar
32720	Tellakula Subba Rao
32721	Vadaparty Veera Venkata Raja Rao
32722	C. Mohan Raj
32723	Har Prasad Nikhra
32724	Jandhyala Bala Bhaskara Sastry
32725	Odugu Venkata Reddy
32726	Ardhendu Bikash Biswas
32727	Syed Masud Akhtar Zaidi
32728	Mahadev Datta
32729	Upendra Kumar Sinha
32730	Rallabhandi Narasimhamurty
32731	Shivrajpur Krishnamurthi Ramachandra Rao
32732	Thirumakudlunarasipur Shivaramasastry Narasimha Murthy
32733	Nitai Chand Chatterjee
32734	Naresh Kumar Bhattacharyya
32735	Gurnam Singh Gupta
32736	Abdul Kabir Siddiqui
32737	Pandurang Govindrao Desai
32738	Krishnaswamy Tulasiraman
32739	Prabir Kumar Chakraberty
32740	Ajay Kumar Bandyopadhyay
32741	Sunil Kumar Biswas
32742	Siddhartha Sen
32743	Sasthidhar Banerjee
32744	Karam Singh Nandre
32745	Mihir Kumar Roy Chowdhury
32746	Dandamudi Raja Raja Narendrudu
32747	Shrikrishna Kumar Garg
32748	T. Appan Srinivasan
32749	Yerradoddi Nagacheenchu Reddy
32750	Suryakant Dalpatram Dave
32751	Alagirisamy Srinivasan
32752	Pinupolu Bapaniah

STUDENTS (*contd.*)

No.	Name
32753	Mukund Balkrishna Govande
32754	Gillela Lakshmi Reddy
32755	Alam Sathyanarayana Chowdhary
32756	Ravindra Narayan Mahajan
32757	R. Muthuvenkatachalam
32758	Kumarasamy Jagadeesan
32759	Panchaksharam Selvaraj
32760	R. K. Rajaram
32761	K. Narasimhan
32762	Kodali Mallikarjuna Rao
32763	Nataraja Kalyanasundaram
32764	Radhakrishna Lakshmanan
32765	Palakode Rajagopalakrishnarao Gururajan
32766	Vasudeva Gopalan
32767	Kulasekaram Gopalakrishnan
32768	Paramkusam Thiruvengalacharya
32769	P. Venkatarathnam Balachandra Rao
32770	P. N. Bakthavatchalam
32771	C. Irshad-ul-Haque
32772	Vengaivasi Jayaraman
32773	Narayanan Balasubramanian
32774	Radhakrishnan Thanikachalam
32775	Palaniappan Sundaram
32776	Tirumala-Kumara Srinivasan
32777	Ganapathy Mahadevan
32778	Venugopal Krishnaraj
32779	Swaminathan Prakash Babu Joseph
32780	M. Jesu Savarinathan
32781	Subramanian Arunachalam
32782	Gorti Suryanarayana
32783	Srinivasan Raman
32784	Subramanian Ramamurthy
32785	Sarangapaniacharier Parankujam
32786	Kailasa Pranatarti Ramakrishnan
32787	Swapan Kumar Bandyopadhyay
32788	Devbrat Bhattacharya
32789	Shamkant Dattatraya Bhise
32790	Samarendra Nath Mukherjee
32791	Sharad Shriram Chitale
32792	Bhalchandra Vasudeo Date
32793	Shamkant Dattaram Kamat
32794	Ram Darshan Gupta
32795	Gomathinayagam Kanthimathinathan
32796	Ashokkumar Mahadeo Mokashi
32797	L. N. Natarajan
32798	Ranjit Kumar Pal
32799	Ram Shobha Pandey
32800	Bhalchandra Balwant Takle
32801	Surendra Kumar Anand
32802	Mir Shouketh Ali
32803	Subramaniam Narayanan
32804	Surjit Singh Sobti
32805	Harihar Singh
32806	Gollamudi Mohana Rao
32807	Bhalchandra Prahlad Inamdar
32808	Narmadeshwar Singh
32809	Supriya Roy
32810	Rajeshwar Prasad
32811	Krishna Mohan Sharma
32812	Anjani Kumar Sinha
32813	Daya Shankar Prasad
32814	Thakur Virendra Kumar Srivastava
32815	Mahadeb Mandal
32816	Gourhari Sinha
32817	Samaresh Chandra Nag
32818	Prabal Pratap Chattopadhayay
32819	Surajit Kumar Sen Gupta
32820	Krishnadhan Basu
32821	Dipak Ranjan Ghosh
32822	Mukta Pada Khan
32823	Sudesh Behari Lal Varma
32824	Nateasapillai Shanmugam
32825	Thirumalachari Narasimhan
32826	Ramsewak Nigotia
32827	Nand Ram Garia
32828	Ram Krishan
32829	Subhash Chandra Phulli
32830	Bidya Nand Singh
32831	Jayant Kashinath Davare
32832	Satya Ranjan Das
32833	Chathanadathu Joseph Thomas
32834	Dattatray Keshav Savarkar
32835	Subir Sen
32836	Kamakhya Charan Ganguly
32837	Ishwar Swarup
32838	Dharm Vir Malik
32839	Ishwar Chandra Tyagi
32840	Rama Pada Chattopadhyay
32841	Adhir Chandra Dutta
32842	Asutosh Sengupta
32843	Satya Narain Tandon
32844	Manomohan De

STUDENTS (*contd.*)

No.	Name
32845	Periyapatna Subrayen Anantha Raman
32846	Gopal Singh Arya
32847	Seshan Narayanan
32848	Basudev Haldar
32849	Mahendra Pal
32850	Asit Kumar Lahiri
32851	Amolesh Kumar Bhattacharyya
32852	Indradeo Prasad
32853	Surendra Kumar Ilwedi
32854	M. Muthukameswaran
32855	Krishna Kumar Asthana
32856	Jati Ranjan Bhattacharyya
32857	K. N. Thirumeelakantan
32858	Babua Jha
32859	Lekhraj Singh Sirohi
32860	Cherukara Velayudhanpillai Ramakrishna Pillai
32861	Munishwar Chandra Gupta
32862	Nageshwar Mishra
32863	Narayanan Parthasarathy
32864	Udai Vir Rastogi
32865	Ram Dhairyya Dwivedi
32866	Narinder Kumar Minocha
32867	Indra Jit Misra
32868	Asit Kumar Kar
32869	Prithwipal Singh Patwal
32870	Suresh Chandra Joshi
32871	Durga Das Upadhyay
32872	Samarendra Kumar Chowdhury
32873	Devamalya Basu
32874	Bhaskar Ambadas Takalkar
32875	Prasanta Kumar Chaudhuri
32876	Mrityunjay Das
32877	Bhan Prakash
32878	Vinay Kumar Bhargava
32879	Jitendra Prasad Verma
32880	Kanaya Lal
32881	Har Charan Singh
32882	Ayyalasomayajula Ramakrishnamurty
32883	Panampulli Balakrishnan
32884	Rajeshwar Prasad Sinha
32885	M. V. Vishnu Nampoori
32886	Sharad Shankar Vaidya
32887	Shri Nath Jain
32888	Dwijendra Nath Banerjee
32889	Krishnamurthy Lakshmikanthan
32890	Satish Chander Gupta
32891	Margabandu Thiyagarajan
32892	Pemmaraju Rajagopalan
32893	Kothapalli Hanumantha Rao
32894	Panchapakesa Srinivasan
32895	Hanumant Dinkar Godbole
32896	Pallattu Narayanapillay Gopalakumaran Nair
32897	Govind Dnyaneshwar Mandhre
32898	Lachhman Dass Narula
32899	Devaguptapu Narayana Murty
32900	Gopal Krishna Mittal
32901	Kailash Chandra Sharma
32902	Datta Shripad Naik
32903	Annathorai Venkataraman
32904	Salek Chandra
32905	Om Parkash Chugh
32906	Krishna Mohan Srivastava
32907	R. M. Nachiappan
32908	Digendra Kumar Bhattacharjee
32909	George Gilbert
32910	Bhandiwad Prehladarao Krishna Rao
32911	Jagan Singh
32912	Mukund Singh
32913	Balaram Krishna Sahay Panday
32914	Bishnu Charan Chatterji
32915	Digamber Ganapatrao Jorwekar
32916	Kalamur Ramanathan Sathianarayanan
32917	Vishwa Mittra Ahuja
32918	Upendra Pratap
32919	Ram Anjor Yadav
32920	Raj Kishore Mishra
32921	Nand Kishore Nayyar
32922	Rajagopalan Doraiswamy
32923	Kalpathi Venkiteswaraiyer Satyavageeswaran
32924	Nikhil Ranjan Das Munsi
32925	Samarendra Majumdar
32926	Arun Kumar Majumder
32927	Jagaipada Baidya
32928	Dileep Kishore Roy
32929	Bimalendu Chaudhuri
32930	Prakash Balkrishna Kulkarni
32931	N. P. Rajendran
32932	Sidheshwar Prasad Singh
32933	Ram Prakash
32934	Ram Dular Singh

STUDENTS (*contd.*)

No.	Name	No.	Name
32935	Sudhakar Shridhar Upasani	32968	Satish Gopalkrishna Ullal
32936	Shiv Prasad Goel	32969	Pratap Chandra Bhattacharjee
32937	Krishnaswamyiyengar Desikan	32970	Raghunandan
32938	Kashi Nath Gupta	32971	V. Gopalakrishnan
32939	Naresh Chandra	32972	Shyam Narain Singh
32940	Tapan Roy	32973	K. K. Viswanathan
32941	Nallasamy Vijayan	32974	Ashoke Kumar Bal
32942	Ved Mitter Kohli	32975	Tapan Kumar Sarkar
32943	Satyendra Nath Kundu	32976	Upkar Singh
32944	Mohammed Iqubal Chand Shaikh	32977	Sheo Prasad Rai
32945	Girish Kumar Shukla	32978	Jagdish Prasad
32946	Dipak Roy Chowdhury	32979	Tarun Kumar Kar
32947	Gautam Sinha	32980	Basudev Chatterjee
32948	Biswanath Das	32981	Arun Kumar Chattopadhyay
32949	Malaya Kumar Mukherjee	32982	Achintya Kumar Saha
32950	Doraiswamy Panchapakesan	32983	Sujit Roy
32951	Saiyid Raisul Hasan Naqvi	32984	Dhiraj Kumar Guha Thakurta
32952	Mude Devagudi Chandrasekhar	32985	Apurba Kumar Bagchi
32953	Purshottam Lal	32986	Kanailal Bishayee
32954	Mohammad Nezamuddin Ansari	32987	Shyama Prosad Nayek
32955	Ramakant Keshav Joshi	32988	Sheo Pratap Singh
32956	Sunil Kumar Mukherjee	32989	Pashu Pati Singh
32957	G. Natesh	32990	Gopi Mohan Banduri
32958	Jatindranath Gangopadhyay	32991	Satyaranjan Sengupta
32959	Sukrit Kumar Sen	32992	George Koshy
32960	Dilip Kumar Sarkar	32993	Gur Prem Dass Vinaik
32961	Mrinmoy Kumar Pan	32994	Prem Narain Gupta
32962	Kamalendu Laha	32995	Koothandath Swaminathan
32963	K. Sankararaman	32996	P. Subbaiyan Viswanathan
32964	Lakshmi Narayan Chowdhury	32997	Madan Lal Khurana
32965	Vasant Gopal Chhatre	32998	Narendra Mohan Malhotra
32966	Tridibesh Sarkar	32999	Manik Lal Ghosh
32967	Niranjan Nandi	33000	Shyamal Kumar Das

OBITUARY

The sympathy of the Institution is extended to the relative of those whose passing is recorded here.

Shri T. S. Sankaran

Shri T. S. Sankaran, B.E., I.R.S.E., M.I.E., died on April 5, 1962, at the age of 61.

After graduation from the Madras Engineering College, he joined the Indian Railway Service of Engineers in 1927, and was given the rank of the Resident Engineer in 1929. In this capacity, he served the G.I.P. Railway, being stationed at various places. Ultimately, he was promoted to the rank of Deputy Chief Engineer, G.I.P. Railway, and later became the Deputy Chief Engineer, Central Railway, which post he occupied till his retirement. He was responsible for many important constructional works during his career as a railway engineer.

Shri Sankaran joined the Institution as Associate Member in 1932, and was transferred to Member in 1952.

Shri M. Gopalan

Shri M. Gopalan, B.E., M.I.E., expired on June 25, 1962, at the age of 74.

After obtaining the B.E. degree in 1912 from the Madras University, he joined the services of the Nizam's Government in Hyderabad as Assistant Engineer in 1913, where he rose to the position of a Superintending Engineer. In his official capacity, he was responsible for the design and construction of various projects in Hyderabad.

Shri Gopalan joined the Institution as Member in 1938.

Shri R. N. Mohgaonkar

Shri R. N. Mohgaonkar, B.Sc., B.Sc. (Eng.), A.M.I.E., died on August 17, 1962, at the age of 50.

After obtaining the degree of B.Sc. (Eng.) of the Benaras Hindu University in 1936, he joined the services of the Government of Central Provinces and Berar as Junior Electrical Inspector in 1938. Subsequently, he became Inspector of Factories, Central Provinces and Berar, Nagpur. He later took up service in the Government of Bombay as Personal Assistant to the Chief Inspector of Factories and held this posion till his death.

Shri Mohgaonkar joined the Institution as Associate Member in 1949.

EMPLOYMENT SERVICE

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In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.